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Radiological Decontamination of Target and Non-Target Vessels

VOLUME 1 OF 3

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DIRECTOR OF SHIP MATERIAL

TECHNICAL REPORT

RADIOLOGICAL DECONTAMINATION
OF
TARGET AND NON-TARGET VESSELS

Volume 1 of 3 Volumes

By:

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NOTE: The above is a list of effective pages in these Volumes. This is Volume 1 of 3.

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PART I
DECONTAMINATION OF TARGET VESSELS

AIR BURST

1. As a result of Test Able on 1 July, no extensive deposit of long life radioactive fission products or alpha emitters was found on the target vessels. Radioactivity existing was induced type and was of very short half life. Within a period of twenty four hours after fission of the bomb the level of radioactivity permitted reoccupation of surviving targets, with the exception of concrete barge YO-160, without radiological hazard. Consequently no decontamination of target vessels was required.

2. Consideration of radiological conditions which might be expected subsequent to Test Baker led to the conclusion that the most important effect from a radiological standpoint probably would be contamination of the lagoon waters. The conditions experienced in Test Able and had a close parallel in the previous three fissions, but the underwater burst was an entirely new phenomenon without precedent. A complete organization of personnel and instruments was set up to study and record the radiological conditions produced in the lagoon as a result of both Able and Baker fissions. This organization initially did not include, however, the gathering of complete scientific data concerning radioactivity on the target vessels.

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3. It was recognized prior to Test Baker that (a) there was a possibility of considerable fall-out of radioactive matter from the cloud of water vapor which would be generated by the burst; (b) a wave approaching one hundred feet in height at the center of the array would dash large amounts of water against the target vessels. As a result of these two effects it was concluded that radioactive matter would be retained in undrained pockets about the weather decks of the target ships and that some would enter the interiors of the ships through vent ducts, stacks and other openings. In order to minimize this effect, all target vessels were secured as for heavy weather and temporary closures provided as practicable for openings caused by Test Able damage. Also, canvas covers were provided for stack openings, vent terminals and other openings not equipped with adequate closures. As a matter of safety and information, initial boarding teams also were instructed to note particularly the radiation conditions existing in pockets where contaminated water might collect. It is of interest to

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note at this point that the initial boarding teams were constituted primarily as a safety organization, with immediate damage and technical observation as a secondary function. Radiological conditions prevailing on the target ships were, at that time, of immediate interest to the Director of Ship Material only insofar as they related to safety of personnel reboarding the ship and in what respects they might impede reboarding, instrument recovery, rehabilitation and complete damage inspection of the targets.

4. The lagoon was reentered by the Director of Ship Material (in RECLAIMER) with vessels of the Salvage Unit (TU 1.2.7) in which boarding teams were embarked. It was found, as expected, that the lagoon waters were much more highly radioactive than after Test Able. Four vessels (APA's) in the southern string and one vessel in the southwest string could be approached and reboarded, as the water in their vicinity and the ships themselves were clear of radioactivity. Access to the remainder of the target array, however, was denied because of the high levels of radioactivity in the water. Some of the outer vessels were approached for short periods. It was found that every vessel approached showed from a distance, levels of radioactivity which would permit boarding for only short periods - generally less than an hour. On Baker plus one and Baker plus two it was possible to approach Hughes and Fallon, but both vessels were radioactive to the extent that taking them in tow for beaching required fast work. The forecastle of HUGHES, for instance, had a tolerance time of about eight minutes. As the radioactivity in the lagoon decreased, it was possible, on Baker plus two and three, for the Director of Ship Material in RECLAIMER to survey quickly all target vessels from about 50 to 100 feet distant. Every ship, except those noted previously, had high radioactivity levels with the exception of CONYNGHAM and CARTERET at the end of the west and southwest strings, both of which had low levels.

5. Since the nature and extent of contamination of the targets was completely unexpected, no plans had been prepared for organized decontamination measures. It was immediately recognized that the functions of the Technical Director and the Director of Ship Material in the Crossroads Tests could not be completed without inordinate delay unless a means of decontaminating the ships expeditiously could be devised. The Director of Ship Material assumed the initiative in con-

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ducting preliminary tests, after conferences with the Radiological Safety Section, to determine whether the contaminating material was subject to removal by any simple and rapid means utilizing materail and equipment readily available.

6. Observations subsequent to Test Able had revealed that pools of water found on target ships were somewhat more radioactive than surrounding deck areas. It was therefore concluded that water might take up some of the radioactive materials in solution. Consequently, on 27 July some of the fire fighting vessels of the Salvage Unit (TU 1. 2.7) were employed to wash down with salt water HUGHES, which had been beached in radiologically clear water. After a wash down of about two hours' duration, radiation readings taken revealed that the intensity had been reduced about fifty percent. A second washing under similar conditions produced no further substantial reduction. Since the radiation readings now were 9.6 R/day on the forecastle and 36.0 R/day on the stern, it was obvious that some supplementary general contamination removal was required even to permit reboarding for limited periods.

7. The next step in the experimental removal of radioactivity was to try application of Foamite to the surfaces since abundant supplies were available in the area. Foamite has a soapy appearance and consistency, and it was hoped that it might have a detergent action with respect to removal of radioactive materials. Foamite was applied by Salvage Unit Vessels to HUGHES on 27 July and incompletely washed off with plain salt water. In areas where washing had been thorough, a resurvey indicated that the radiation intensity had again been reduced by fifty percent. Another application of Foamite was then made to HUGHES and allowed to remain overnight. The following day (28 July), a thorough wash down with salt water, again using the Salvage Unit Vessels' fire fighting facilities, once more reduced the level of activity by fifty percent. The maximum readings at this time were 3.0 R/day port, and 8.5 R/day starboard, with an average of about 2.0 R/day on the main and forecastle deck levels. The high reading on the starboard side was considered attributable to the fact that the beached location of the ship allowed use of monitor nozzles only on the port side in washing, whereas portable pumps in an LCM were used for the starboard side wash. The reduction in readings obtained was

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most encouraging and, although much of it was due to natural decay, there was no doubt that considerable acceleration had been produced by the processes being used. This fact was further borne out by the differences between the radiation intensities on the port and starboard sides as mentioned. As a result of these experiments, it was felt that, pending development of better methods, washing and foamite applications should be made in accordance with a prepared achedule as soon as practicable and as consistent with considerations of salvage operations, recovery of instruments and the value of target vessels as technical specimens. It had been found from experience in the period since Test Baker that water slightly contaminated tended to deposit its contained radioactive materials on surfaces of systems and equipment exposed to sea water and in marine growths on underwater bodies of operating vessels. It was therefore necessary to wait until the salt water surrounding the target vessels was radiologically clear before proceeding with the washing. It was also obvious that the washing methods developed were not by any means a complete nor a wholly satisfactory solution to the problem and that further study was imperative.

8. On 27 July a conference was held with the Radiological Safety Section in which the need for developing a satisfactory method of rapid removal of radioactive materials from the targets was emphasized. It was requested that a detailed study be undertaken immediately to evolve a suitable method. In response to this request various samples of contaminated equipment were selected for conduct of special tests by the Radiological Safety Group. The objects were blasted with soft grits such as ground corn cobs, coccanut shells, rice, barley, ground coffee, rice hulls and sand using a diesel driven air compressor rated at 315 cu. ft. per minute at 90 psi., and introducing the material through a simple eductor arrangement. The specimens treated included electric lanterns, copper pipe, a plastic coffee maker, angle irons, aluminum angles and sheets, a brass boat hook, junction boxes of brass and bakelite, a brass shower drain screen and galvanized steel plate. The following were the findings of the tests:

(a) Painting over the surface produced no reduction in activity since the radiation was primarily gamma.

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(b) Blasting copper pipe with grain rice reduced activity to one-half, but complete removal could be achieved only with sand.

(c) Painted objects could be partially decontaminated by blasting with coffee without injury to the surface, but complete decontamination required removal of all paint.

(d) Radiation intensity from a brass casting which was porous from dezincification was reduced from 4.5/R to 2.0 R/24 hrs. by blasting with rice, but further treatment with rice or sand failed to yield additional results.

(e) Brass surfaces could be decontaminated with nitric acid. There findings showed that radioactive material could be removed from surfaces by wet sandblasting, or partially by blasting with various soft grits. However, these measure are not suitable for general decontamination of a target ship in the field and their usefulness was restricted primarily to clearing local areas.

9. The Director of Ship Material made a small scale laboratory study on 28 and 29 July to investigate the possibility of decontaminating by use of various materials available locally or readily obtainable from Pearl Harbor. The possible methods of removal of radioactive materials investigated were (a) detergent action by soap powders, lye and volatile naphtha; (b) dissolving action by acetic, hydrochloric and sulphuric acids; (c) absorption by flour, cornstarch, activated charcoal and sandblasting. The first results of the investigation revealed that the source of the radioactivity lay in the collection of radioactive materials on or in wood, paint coverings on metal, and on rough and rusted metal surfaces. It also was noted that radioactive materials were retained to a remarkable degree by all exposed organic materials such as canvas, life rafts, manila line, swabs, brooms, wood decks and the like, and all exposed items of these materials observed were very heavily contaminated. All of the reagents listed above were tried on painted wood, steel and canvas surfaces. None was sucessful in the removal of the radioactive materials with the exception of a prolonged washing in a five percentsolution of acetic acid solution. This process was not suitable for expeditious mass application to the target ships by methods known at the time. The other reagents accomplished reduction of radioactivity only to the extent that they actually removed the paint or surface corrosion.

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10. On 28 - 30 July a series of experiments on a larger scale was conducted supplementing the laboratory studies. A vessel of the Salvage Unit sprayed exposed surfaces of TUNA first with diesel oil and later with a solution of lye and boiler compound. Each application was followed by a thorough washing with plain salt water. The diesel oil produced negligible results, but the lye and boiler compound solution reduced the average readings immediately by about sixty-six per cent. The same solution on SKATE produced very poor results, but a large portion of the superstructure of this ship was missing as a result of Test Able and most of the remaining surfaces were painted with black plastic or bituminous enamels which were not affected by the lye soulution. The application of lye and boiler compound on TUNA had removed a considerable proportion of the paint from exposed surfaces. Both the laboratory and large scale experiments of 28 - 30 July thus clearly indicated that the most practicable means of early decontamination of the target vessels lay in the use of a mixture having detergent qualities strong enough to remove outer layers of paint. The problem remaining was to develop techniques and procure the necessary materials and equipment to accomplish this end.

11. The method selected for the actual removal of contaminated materials was based on the reduction of radiation intensities by use of wholesale washing processes until levels were reached at which inspection and instrumentation personnel and small groups of ship's force could remain aboard safely for periods of at least two hours. Ship's personnel in relays would then apply detailed scrubbing, abrasive and paint removal action as necessary to reduce the radioactivity sufficiently to premit continuous habitation of the ships. It was also an urgent necessity to remove animals to obtain instrumentation records and to proceed with post-technical inspections. Some vessels required reboarding for pumping out flooded spaces. Appropriate instructions as to procedures to be followed, clothing to be worn and detailed safety precautions were promulgated to all target ships. In addition, necessary personnel were informed as to the methods to be used and the hazards involved, by conducted demonstrations to school ships' crews in the operations to be followed. Detailed instructions issued by the Director of Ship Material are included with Appendix IV.

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12. Briefly, the program consisted of the following steps·

(a) Ship thoroughly washed down with plain salt water.

(b) Radiological monitor, DSM representative and ship's force representative board ship, make quick preliminary survey of radiological conditions and note particularly hazardous areas. Boarding party together with Commanding Officer of salvage vessel formulate plan of action to proceed with decontamination.

(c) If conditions permit, ship's force working party boards vessel, removes all exposed organic materials, working in relays as necessary to avoid overexposure. If radiation intensities still prohibit this action, paint removal mixture must first be applied as below.

(d) Prepare paint removal mixture of 450 lbs. lye, 600 lbs. boiler compound and 75 lbs. of cornstarch with sufficient water to produce 1000 gallons of mixture. Lye and boiler compound are added gradually to 500 gallons of water, mixed and dissolved. Cornstarch is mixed separately in a thin suspension and added gradually to produce smooth suspension. Fresh water is added to produce 1000 gallons. Batch is heated by steam hose until starch swells and boiler compound dissolves completely. The mixture is applied by Chrysler salvage pump taking suction on tank and discharging through 1 1/2" fire hose with all purpose nozzle or fog nozzle with applicator. All painted surfaces of the target vessel are thoroughly coated with the mixture. After an interval of about two hours ship is again hosed down vigorously using monitor nozzles with maximum force available to remove all possible paint. Care is exercised to leave no gaps and to sweep all paint chips clear frequently by use of the hose in order to minimize transfer of contamination to other surfaces.

(e) Following this process, target vessels are again reboarded by the DSM representative with a monitor, Radsafe representative and a responsible officer from the target vessel. The general radiation level is checked at this boarding to ascertain whether the vessel is not safe for small working parties is relays to apply detailed decontamination measures. All spots remaining highly

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radioactive are noted and the source of the excessive radiation determined if practicable. If the spots are too extensive and apparently the result of gaps in the paint removal process, it may be necessary to repeat the applicable steps in the paint removal procedure to reduce the activity of the recalcitrant areas. If, on the other hand the vessel is determined to be safe for working periods of four or more hours, detailed decontamination measures by the ship's force can proceed.

(f) For prosecution of detailed decontamination procedures, all radiological dangers when found are marked clearly and if necessary roped off to keep personnel at a safe distance. Monitors are present at all times to insure that personnel do not remain on the ship beyond tolerance hours set. Detergent mixtures similar to those used for the gross decontamination are applied to painted surfaces remaining above tolerance for continuous habitation. Long handled scrubbers, holystones, and other similar devices are used to scrub the surfaces, and any available means of aiding the mixture in the removal of paint, rust, scale and the like are resorted to. Each operation is followed by a vigorous, plain salt water hosing to wash all removed contaminated material from the ship. The process is repeated several times in affected areas until tolerance limits for continuous operation are attained.

13. General washing with salt water and application of this formula carried out during the period of the above investigations in accordance with a priority list as soon as the water around each of the involved vessels became clear; the use of foamite was abandoned as being less effective. Detailed decontamination by ship's force in accordance with the instructions promulgated by the Director of Ship Material was commenced at once on the lightly contaminated vessels such as CONYNGHAM, WAINWRIGHT, CARTERET and SALT LAKE CITY. Meanwhile ten vessels of the Salvage Unit (TU 1.2.7) were outfitted to carry out the gross decontamination of other more heavily contaminated targets by applying the detergent mixture. This outfitting was completed on 5 August. Five APA's, BLADEN, CORTLAND, FILLMORE, GENEVA and NIAGARA, not exposed to the radioactive fall-out, had been cleared on Baker Day. These vessels were reboarded immediately and accomplished local decontamination by scrubbing with soap and water and washing down sufficiently to obtain radiological clearance for complete rehabilitation.

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14. The application of the new gross decontamination measures progressed very satisfactorily in spite of many handicaps. Decontamination by ship's force was begun on the following target vessels in addition to the five APA's which had already been cleared as stated above:

SALT LAKE CITY	(CA 25)
NEW YORK	(BB 34)
NEVADA	(BB 36)
PENNSYLVANIA	(BB 38)
PRINZ EUGEN	(IX 300)
CARTERET	(APA 70)
WAINWRIGHT	(DD 419)
CONYNGHAM	(DD 371)
MUGFORD	(DD 389)
WILSON	(DD 408)
PARCHE	(SS 384)
DENTUDA	(SS 335)
TUNA	(SS 203)
SKATE	(SS 305)
SEARAVEN	(SS 196)

Appendix I contains detailed reports of procedures followed on several representative ships.

15. The accomplishment of the gross decontamination measures involved many practical difficulties and many hazards. Great care was necessary to insure that the length of time during which the salvage vessel might be alongside the target without dangerous exposure was not exceeded. It was, of course, highly desirable for the salvage vessel actually to put a line over to the target vessel to insure an effective treatment of the target, but some targets were radioactive to a degree which prohibited closing to less than fifty feet except for very limited periods. Great care was necessary also to avoid washing contaminated materials into the target vessels. In addition it was necessary to skip entirely certain areas around open hatches, large air intakes and other openings to prevent introduction of large volumes of water and paint removal mixture into the ship' interiors. Aside from all this, the paint removal material itself, containing large quantities of lye, was

hazardous to handle. Protection of personnel against both chemical and radioactive hazards was of paramount importance during these operations.

16. The work required by ship's force decontamination was laborious and largely manual; it required considerable time and hazards were involved from the standpoint of both radiological considerations and danger of injury in handling paint removal mixtures prescribed. In the course of the work, decontamination of specified areas of steel decks was attempted by use of scrubbers with strong solutions of first acetic, then hydrochloric acids following each scrubbing with a thorough wash with salt water. The superiority of this process over scrubbing with plain salt water was not sufficiently marked to justify adoption. In view of later information and experience, however, it is considered that because the areas so treated were small and surrounded by large masses of radioactive material, the readings obtained were indicative of the general radiation level or "background" of the vicinity rather than the condition of the treated surface. However, general acid application was not developed into a practical method. Attempts were made to reduce the activity of wood decks by holystoning with sand, lye and boiler compound on SALT LAKE CITY and NEW YORK. NEW YORK's decks showed considerable acceleration over natural decay rates, but SALT LAKE CITY's indicated no improvement. The lack of success in the latter case is considered at least partially attributable to the fact that adjacent painted steel surfaces were being decontaminated simultaneously and, as a result, contaminated water was being washed over the wood decks almost constantly. Also the ship's general radiation level undoubtedly obscured the actual results.

17. During the course of decontamination by ship's force, elaborate measures were required to protect personnel against radiological hazards. In addition to providing monitors on all ships at all times that personnel were aboard, rubber boots and rubber gloves were necessary since shoes and cloth or leather gloves are quickly contaminated, and the fission products attaching themselves are most difficult to remove even by laundering. All personnel were required to be fully clothed at all times and to take showers and change clothes after each operation. All clothing worn was required to be laundered after

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each day's work. Special change facilities and showers were set aside for this purpose on the target APA's which had been cleared. Special laundry facilities were also designated for washingthe contaminated clothing in order to avoid contaminating general laundries. Even with the most elaborate precautions it was necessary to exercise constant vigilance to insure that all personnel were safeguarded adequately. In spite of all handicaps, however, the work proceeded very satisfactorily.

18. On 9 August, the Director of Ship Material requested the Radiological Safety Officer and the Commander Target Group to visit ships on which ship's force were employing the detailed decontamination procedures. During that inspection, samples of materials were obtained from areas of the wardroom of PRINZ EUGEN for which geiger counter readings showed radiation intensities sufficiently low to permit extended personnel exposure without danger of injury. An analysis of the samples revealed the presence of alpha emitters which were not detectable with the monitoring instruments in use at Bikini. Further investigation showed probable widespread presence of the alpha emitter in the target area even in spaces not obviously contaminated. Since no alpha detectors for general field use were available and the alpha emitters are one of the most poisonous chemicals known, their presence was considered a serious and indeterminate menace to personnel exposed for indefinite periods of time on contaminated target vessels without special complex protective equipment and trained personnel to detect the alpha emitters. A conference was called by the Task Force Commander on 10 August to discuss the matter. As a result of this conference, continuation of detailed decontamination was considered unsafe under the existing conditions, and all further decontamination work on the targets by ship's force was ordered discontinued. Subsequently, all further work on these vessels by Task Force Personnel was limited to recovery of instruments, limited surveys, salvage work and preparations for towing from the area.

19. It was unfortunate in many respects that the decontamination procedures instituted had to be discontinued as a result of the investigation requested by the Director of Ship Material on 9 August. It is fortunate, of course, that the analysis of remaining products was made since the facts revealed thereby precluded the possibility of exposing large numbers of personnel to a hazard not detectable by instruments at hand. However, the planned procedures of pre-

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liminary decontamination by spraying and washing from salvage vessels close aboard, followed by short clean-up and monitoring of upper decks, with thorough spraying and washing from alongside as necessary, and finally, detailed decontamination by the ship's crew were not carried out for a sufficient period to permit proper evaluation or determination of ability to reduce levels of radioactivity to acceptable tolerances by these methods. Even if this had been possible, the removal of alpha emitters would still have been a problem not susceptible to field solution.

20. In order to appraise the value and effectiveness of the decontamination procedures that were used on the surfaces of the target vessels, it is necessary to examine briefly the nature of the contamination existing. Post-Baker investigation revealed that about fifty percent of the total radioactive material produced by the explosion remained in the waters of the lagoon. Readings taken at very early stages showed that invariably the largest part of this material was deposited on the surface of the water and very little, if any, was present near the bottom. This means that most of the contamination resulted from the base surge, the following wave and then the rain and spray fall out which covered the bulk of the target area for a considerable time after detonation. In the cloud resulting from the explosion there were in addition to the fission products, undoubtedly elements from the sea water which had induced radioactivity, the most important being sodium. The materials were rained down on the ships over a wide area and upon evaporation of the water were deposited on the surfaces where they fell. Large quantities of highly radioactive coral and sand also were deposited on the ships. The area affected extended from about 1800 yards upwind to more than 4000 yards downwind and about 3000 yards crosswind. All but nine of the target vessels in the array were heavily contaminated by the rain and spray. Most of the water deposited ran off the ships and such variations as existed in degree of contamination were probably due to the characteristics of the design of the ship, its age and the condition of the exposed surfaces rather than its distance from the center of fission. It is also possible that the rain was at an elevated temperature and tended to penetrate and soften the paint as well as deposit itself on the surface. The concept of contamination by the "base surge", or wave of vapor emanating from the center of fission, is as yet imperfectly understood. More study of this phenomenon may modify considerably some of the above assumptions. The retention on the surfaces also was aided by ion-ex-

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change since the long lived fission products deposited in seawater are known to be largely polyvalent cations which would displace easily the monovalent sodium and potassium cations which would normally be present on paint, rust, scale, algae and similar surfaces exposed constantly to sea water and known to have a high ion-exchange capacity. Further, the fact that fission products were present in low concentration and submicroscopic form, even though the solutions were highly radioactive, aided the exchange absorption of the products.

21. Accurate evaluation of the decontamination measures instituted is very difficult to make because of unreliability of instruments, the irregular variation of readings and the lack of uniformity in methods of reporting radioactivity. Also, data are incomplete since many of the ships were too highly radioactive to board prior to first gross decontamination. Probably as a result of ion-exchange as discussed above, all rust, dirt, loose paint and organic materials tended to hold the contamination and became much more highly radioactive than clean, well drained surfaces. The initial washing process removed much of the material of this type, but probably did very little, if anything, toward removing imbedded or attached ionized radioactive materials from surfaces remaining. The lye-boiler compound - starch mixture developed for the purpose was designed to have a detergent action and to remove the outer paint layer and the attached or imbedded radioactive materials with it. It is significant to note that the processes used were effective only insofar as they accomplished this function. It was found in the short experience gained that difficulties of application on the large scale required also prevented better results. Furthermore, there was the necessity for haste in order to complete the Director of Ship Material and Technical Director missions, and to avoid retaining any of the Task Force in the lagoon under undetermined conditions of exposure more than a minimum of time. Some of the contamination was transferred to under surfaces, corners, scuppers and drains and resisted removal by the methods in use. The procedures adopted did not have a pronounced effect on wood decks, canvas or unpainted surfaces. The abrasive scrubbing with sand and holystones was successful to some degree on wood and bare surfaces insofar as it removed the outer and more heavily contaminated surfaces. There is some doubt as to the efficacy of the holystoning on the decks, however, as it appears that some of the activity re-

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moved was re-transferred to the cleaned surfaces in the associated washing and that one effect may have been to drive the radioactive material in deeper.

22. The gross decontamination by Salvage Unit vessels from alongside was fairly successful in cleaning the ship as a whole and also in concentrating on limited areas. The higher structures of the targets were difficult to reach to apply the paint removal mixture. Further, this mixture did not loosen the paint to a sufficient degree to permit removal by ordinary washing but required the full force of a stream from a monitor fire-fighting nozzle to realize good results. Because of this fact, removal of paint from most of the upper decks of target vessels was incomplete since the monitor nozzles could not be brought to bear forcibly by reason of height and screening of the areas by splinter and weather shields. That the work was generally effective, however, can be illustrated by a specific case such as the BRACKEN. This vessel received a complete gross decontamination, but no ship's force work was accomplished. On boarding to remove animals on 27 and 28 July, the average geiger counter reading on the exposed main and superstructure decks was 11.0 R/29 hours. The ship was given a coat of foamite on 31 July and washed the following day. The ship was again washed down on 3 August and on completion of this treatment showed an average topside reading of 1.7 R. On 6 and 7 August the ship was sprayed with paint removal mixture and after washing down showed an average reading of 0.3 R/24 hours, and an elapse of two more weeks would have been required for the average intensity of radiation to have reached 0.3 R/24 hours by natural decay.

23. It is regrettable that necessary procedures were not established for obtaining more accurate and detailed information as to conditions of radioactivity existing on target vessels both before and after decontamination. Pressure of time and limitations of facilities, instruments and personnel available, however, precluded the achievement of this goal. Much also can be ascribed naturally to the lack of information and realization of the conditions to be expected. Consequently, it was impossible to plan for them, which is to be expected in the first experience with a phenomenon of this magnitude and scope. The decontamination measures adopted as an ex-

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pedient after Test Baker, although successful to a certain extent in the limited application they received, revealed conclusively that removal of radioactive contamination of the type encountered in the target vessels in Test Baker cannot be accomplished satisfactorily for wartime application from the standpoint of time and effort with standard equipment now readily available. The measures employed, however, were effective enough to permit removal of instruments and instrumentation records, technical inspection of the vessels, removal of animals and salvage operations. Otherwise portions of the Task Force would have been delayed in the lagoon for one to two months.

24. The following program of further action in radiological decontamination investigation and development was clearly indicated as a result of the early experience with Crossroads targets:

(a) Extensive study and analysis to determine the exact nature of the contamination resulting from Test Baker.

(b) Broad research to develop satisfactory methods of large scale decontamination of ships.

(c) Careful study of surface characteristics with respect to radioactive contamination and research to develop suitable surfaces to minimize contamination.

(d) Appropriate education of naval personnel in matters of radiological hazard and instruction in methods of decontamination when developed satisfactorily.

(e) Necessary design changes in ships to reduce contamination and its effects and to facilitiate removal of such contamination as cannot be avoided.

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PART II

DECONTAMINATION OF NON-TARGET VESSELS

1. As stated in Section I above, it was noted soon after Test Baker that the radioactive fission products were absorbed readily by rusty, porous and scaly surfaces loose paint, marine growths and algae. This fact was demonstrated forcibly on the lightly contaminated target APA's, which showed considerable radiation intensities on the outer shell in the vicinity of the waterline. The radioactive materials were lodged almost entirely in the marine growth and rust adhering to the shell. These vessels using ordinary paddle type bottom scrapers removed as much as practicable of the growth in the waterline area and thereby reduced considerably the amount of activity in that vicinity. They next proceeded outside the lagoon and steamed at high speed for a period of about 24 hours. The erosion of the water incident to this steaming resulted in a further reduction by about fifty percent. Continued steaming did not result in additional reduction of activity, however. Upon return to port, GENEVA wire-dragged the entire bottom using hogging lines and walking them down the length of the ship. This operation resulted in reducing the radiation levels inside the ship in the vicinity of the shell to tolerance limits for continuous occupancy.

2. After re-entry of the non-target vessels to the lagoon, the same tendency of radioactive materials to adhere to the outer shell below the waterline was observed. The conditions here were ideal for ion-exchange and although the water itself showed intensity of radioactivity at and near the surface of only about .01 R/day, the active matter was absorbed so efficiently from the lagoon waters that within a period of three days several of the non-target vessels began to show geiger counter readings of greater than 0.1 R/day of gamma radiation inside the hull in the vicinity of the waterline. Consequently, these areas became unsatisfactory for continuous occupancy. In addition, salt water lines and salt water systems continuously circulating lagoon water in firemains, condensers and evaporators began to show increasing gamma radiation readings on exterior surfaces to the extent that certain areas adjacent to these systems were in excess of tolerance. A potential hazard to personnel

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standing watches near this equipment was apparent if vessels were permitted to remain in lagoon areas contaminated to any appreciable degree.

3. Upon discovery of the radiological conditions prevailing and the constant increase in contamination being suffered, all non-target vessels and those target vessels which had been cleared were moved to the southeastern portion of the lagoon, where the waters were clear, to await the action of natural decay and dispersion of activity by tides and currents in the normal anchorage area. Meanwhile, it was realized that wherever algae, rust, sediment and calcareous marine growths on the ships' hulls or in the ships were exposed to radioactive materials in the water there would be an ever increasing absorption of the materials taking place. Furthermore, the action of evaporators tended to deposit this material in the scale on the shells and tubes, indicating that radioactive elements were either in solution or suspension in the waters of the lagoon. The removal of scale by manual methods therefore became a hazardous matter, because of the high gamma and beta radiation intensities encountered as a result of this accumulation.

4. All vessels were directed to list ship as much as practicable by shifting liquids and to scrape algae, fouling and scale from portions of underwater bodies thus exposed. This operation aided considerably in reducing the activity in the waterline area of the ships. In addition, strict instructions were issued to all vessels not to open up evaporators without specific authority from the Radiological Safety Section and then only in the presence of a qualified monitor.

5. It was obvious that the only feasible immediate means of reducing and maintaining at low levels concentrations of radioactive materials in evaporators lay in removing scale by non-manual methods and attempting to reduce or eliminate reformation of this scale. Tests were conducted and showed that so long as evaporators were operated at low enough rates to prevent priming, no carry-over of radioactive products into distilled water would result. As a factor of safety, however, all ships were directed to steam evaporators not in excess of 80% of capacity. In order to remove scale existing, all ships equipped to do so were ordered to cold shock tube nests. To reduce to a minimum formation of additional scale, standard instruct-

ions, for introduction of boiler compound and cornstarch into evaporator feed water on a continuous basis, which had been universally successful in reducing hard scale formation in naval vessels, were republished by the Director of Ship Material and the Force Maintenance Section and distributed to all non-target vessels. The application of these measures resulted in the reduction of activity in most ships to tolerance levels (0.1 R/day or less gamma) and further significant increases in activity were avoided by keeping the bulk of the non-target ships in waters which showed less than .001 R/day of gamma radiation. In order to carry on essential functions a good many exceptions were necessary, however such as the vessels of the Salvage Unit which were working with the Director of Ship Material on decontamination and inspection of the targets, the vessels of the Radiological Safety Patrol which were monitoring the target ships and the lagoon waters, the Survey Unit craft which were engaged in obtaining scientific data incident to the tests and several others. The only immediate solution on these vessels lay in constant monitoring, restriction of hazardous areas, and scheduling of operations wherever possible in a manner designed to avoid further increase in radioactivity of portions of the ship already at dangerous levels. No satisfactory means of decontamination of underwater bodies and salt water systems in the Bikini area was apparent. In some extreme cases vessels were actually anchored and personnel evacuated for radiological safety reasons until the radioactivity had decayed sufficiently to permit continuous habitation and performance of essential functions without exposing personnel to more than 0.1 R/day.

6. During the period subsequent to Test Baker, all non-target vessels of the Task Force which had re-entered the lagoon and had any possibility of being contaminated to any appreciable degree were monitored carefully. Each of these vessels which showed radiological contamination of sufficient intensity to produce any possibility of over-exposure of personnel to gamma radiation was provided with instructions as to steps to be taken to prevent radiation injury. These instructions in most cases consisted in the main of limitations on the time any person would be permitted to remain in a particular compartment or vicinity of a piece of equipment which was heavily contaminated. It was hoped that the extensive steaming in the open sea following departure from the Bikini area combined with natural decay would remove all radioactivity hazards to personnel on non-

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target vessels. Because of lack of sufficient detailed information, it was not possible at that time to predict how long the existing contamination would continue at sufficient intensity to represent a hazard.

7. It became apparent as time went on that natural decay and normal steaming in uncontaminated water would not necessarily reduce the radioactivity to negligible amounts. All ships which had been in Bikini lagoon during any part of the period from 25 July to 10 August were advised therefore by CJTF-1, Serial 075 (included as an enclosure to Serial 079 in Appendix II) on 19 August that further monitoring would be required before ships could be considered completely clear of radioactivity, particularly to insure safety of personnel engaged in future work on ships' sides and evaporators since these had been found to be the two principal collecting points for radioactive matter on the non-target vessels. Arrangements were made immediately to provide radiological monitors to medical officers of the 11 th, 12th, 13th and 14th Naval Districts and Guam to be available for call to activities handling suspect vessels. Commanding Officers of ships involved were advised to apply to District Medical Officers for such monitors prior to opening up evaporators or other contaminated machinery and before entering drydock.

8. The Radiological Safety Advisor and the Safety Advisor concluded, after further study and analysis, that the precautions outlined in the instructions of 19 August were inadequate for protection of personnel against possible injurious effects resulting from introduction of alpha emitters into their bodies by exposure to contaminated surfaces or dust and fumes emanating from these areas, irrespective of the gamma and beta radiation hazards. It also was decided at that time that considerable cleaning would in some cases be required to eliminate this additional potential hazard, and that the cleaning operations and the disposal of the products involved constituted new problems of a unique nature. On 29 August Commander Service Force Pacific, after conference with the Safety Advisors, promulgated special precautionary measures to be taken immediately until further development of the situation, and to be applied to all vessels exposed an accumulated time of ten or more days in Bikini lagoon subsequent to 25 July. The precautions were briefly as follows:

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PRECAUTIONS

(a) Avoid drydocking until receipt of detailed instructions.
(b) Avoid exposing any internal or external salt water surfaces.
(c) Avoid exposing personnel to fumes resulting from welding or cutting, or dust originating from surfaces contaminated by salt water.

A copy of this directive is included as part of Appendix IV. Commander Service Force Pacific also recommended assembly of all vessels, other than targets, exposed ten or more days and at or enroute to the West Coast, in one area, preferably San Francisco, for detailed determination of radiological status and proper indoctrination of personnel concerned in future operation and dispositionof the ships. San Francisco was suggested because of favorable anchorages and proximity of radiological laboratories. For the ships in the Pearl Harbor area, Commander Service Force stated that suitable radiological personnel would be provided and maintained in that location.

9. On 28 August, Commander Joint Task Force One in a message to the Chief of Naval Operations and the Commander in Chief Pacific concurred in the precautions and recommendations set forth by Commander Service Force. Commander Joint Task Force One cited, however, the undesirability of returning ships in the Marianas, Philippine or Asiatic waters to San Francisco, and advised that necessary monitors and equipment could be flown to Guam or other selected location for clearance of vessels concerned. He advised also that a monitoring organization was being arranged to be available to Commander Naval Base, San Francisco or other authority to whom returning ships would report on arrival, and would provide clearance facilities at Pearl Harbor. Commander Joint Task One recommended that immediate steps be taken meanwhile to avoid docking or yard work on any of these ships until after complete monitoring and clearance had been accomplished, and noted that the precautions set forth for suspect ships also applied to boats carried by those ships.

10. The Chief of Naval Operations directed compliance with the recommendations of Commander Joint Task Force One on the same day (28 August), and on 30 August directed that all boats found radiologically unsafe after monitoring under the direction of District Medical Officers be sunk at sea in deep water. Later, on

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UNC[illegible]

3 September, the Chief of Naval Operations modified his original orders by informing the Commander in Chief Pacific and Commander Western Sea Frontier that diversion of some Crossroads ships to other principal West Coast Ports as mutual ly satisfactory to the commands addressed was authorized if unacceptable congestion in the San Francisco area would result otherwise. At the same time he advised that Commander Joint Task Force One would provide monitoring and clearance at other ports when advised of diversions, but directed that diversions be held to an essential minimum because of superior radiological safety facilities in the San Francisco area. In this dispatch he also suggested that vessels concerned in the Marshalls and destined for Eastward proceed to Pearl Harbor or San Francisco, preferably the latter. On 3 September, the Chief of Naval Operations also directed the Bureau of Ships to comply with Commander Joint Task Force One recommendations that drydocking and Navy yard work be avoided until complete radiological monitoring and clearance had been obtained.

11. In order to implement the ship clearance program, the Force Medical Officer, Captain W. E. Walsh, (MC) USN, had been detailed to brief District Medical Officers at Pearl Harbor and on the West Coast, and to establish the contemplated ship clearance organization. On 26 August, Captain Walsh set up headquarters in the offices of the District Medical Officer, Twelfth Naval District, and thereby officially established the ship clearance organization in its first form. The terminology and functions of this organization were later defined by Commander Joint Task Force One as follows:

(a) Clearance is the certification of the fact that a ship is radiologically safe for unrestricted use.

(b) The provision of clearance facilities includes not only the furnishing of monitors and certification of clearance if the ship is found uncontaminated, but also the rendering of advice and technical assistance to accomplish the elimination of such contamination as is found to exist.

(c) In some cases it will be found impracticable to accomplish this complete elimination, whereupon only a conditional clearance will be given setting forth what further decontamination will be required and what precautions must be taken in the interim.

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12. The ship clearance organization at the outset had considerable difficulty in obtaining sufficient radiological monitors to handle the vessels arriving in San Francisco. Additional personnel were obtained from HAVEN and from officers who had served as monitors during the period at Bikini. It became apparent immediately, however, that the problem in hand was far greater than had been anticipated and that extensive decontamination of most of the returning vessels would be required before complete clearance could be granted. This realization was further complicated by the fact that no safe and effective methods were yet known by which the radioactive materials could be removed from surfaces and systems of the type and on the extensive scale required by contaminated ships. The measures recommended by the monitors in accordance with the information provided them were, at best, only partially effective and grossly inadequate to meet the problem. They consisted largely of precautionary measures without positive steps to eliminate the hazard except by such removal as might occur through continued use of the parts affected. These measures were principally as follows:

(a) Treat evaporators by use of starch and boiler compound, cold shocking, or, in the case of vapor compression stills, standard acid cleaning.

(b) Sink at sea radiologically hazardous lines, fenders, nets, camels, brooms, swabs and other fibrous, vegetable materials.

(c) Prohibit burning, welding, chipping or wire brushing of salt water lines or exposed salt water surfaces except under supervision of monitor. Scraping is permitted on surfaces provided they are kept wet at all times.

(d) When dropping the anchor keep personnel away from the dust formed, deep anchor chain as wet as possible during the process and use gloves when handling, discarding gloves after use.

(e) Sink in deep water small boats or parts thereof with readings in excess of 0.1 R/day. For other boats showing appreciable readings, scrape all wood and metal surfaces using a completely wet technique; catch scrapings on a canvas spread below the boat and discard overboard; paint all boats; replace all boat salt water lines as soon as possible as a further safeguard.

(f) Scrub all urinals and head troughs with abrasive cleaner and/or acid solution.

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13. The limited decontamination measures outlined above combined with additional decay incident to the operation of the contaminated ships resulted in almost all cases in only conditional clearance. The Commander in Chief Pacific on 7 September expressed considerable concern over this situation pointing out that such clearance would permit temporary operation, but in most instances would result in eventual immobilization because of restrictions on work. The conviction was expressed that Commander Joint Task Force One should initiate early action to establish procedures and facilities for the complete radiological clearance of all contaminated vessels, particularly those assigned to active fleets. The unsatisfactory situation prevailing was echoed by Commander Western Sea Frontier in a dispatch of 9 September to the Commander in Chief Pacific. In this communication, Commander Western Sea Frontier stated that districts had insufficient personnel to effect full clearance of vessels and, furthermore, no one yet knew how to decontaminate. Consequently, several APA's, Destroyer Division 72 and some auxiliaries had been cleared partially to meet operational requirements on the basis that they might as well continue to operate until methods of making them safe for overhaul were developed. The thought was expressed that all vessels so cleared would be required to return to San Francisco for full clearance when more information had been developed. On this score, there was no estimate as to time which might be required. Commander Western Sea Frontier flatly stated that the insufficiency of the measures being employed was recognized clearly and that every effort was being made to expedite means of dealing more fully with the problem.

14. On 9 September 1946, Commander Joint Task Force One promulgated his serial 079 addressed to the Commanding Officers of all Crossroads non-target vessels which were suspected of being contaminated by radioactive material. The stated purpose of this letter was to advise all Commanding Officers of the nature and content of the important pertinent communications which circulated the information as to the radiological contamination of the non-target ships, to summarize safety precautions and to give information as to the monitoring and clearance organization and procedure. A copy of this serial is attached as Appendix II. Serial 079 did an admirable job of supplying information intended. However, it accomplished little, if anything, towards expediting final radiological clearance for the following reasons:

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(a) It failed to establish adequate decontamination procedures or to set up a plan for developing them.

(b) It did not establish the final tolerance for the alleged principal radioactive hazard, alpha emitters.

(c) It did not specifically place the responsibility on any command or group for accomplishment of decontamination and obtaining final clearance.

On the same date, Commander Joint Task Force One designated Captain W. E. Walsh by dispatch as his representative in coordinating radiological monitoring and clearance of ships in the 11th, 12th, 13th, 14th Naval Districts and at Guam.

15. All cognizant commands were becoming exercised over the disruption of operational, overhaul and demoblization schedules caused by the almost universal contamination of the returning non-targets and the apparent lack of success in dealing with the matter. This attitude was reflected by a dispatch from Commander in Chief Pacific to the Chief of Naval Operations on 10 September in which the former suggested that vessels whose condition warranted only conditional radiological clearance be sailed to berthing or disposal areas for decontamination in order to release personnel of radioactive ships destined for the Nineteenth Fleet and for disposal. The Chief of Naval Operations concurred in this movement as mutually agreeable to Commander in Chief Pacific and Commander Western Sea Frontier. On 11 September, however, Commander Western Sea Frontier advised the Chief of Naval Operations that although he appreciated the urgent need for release of crews, considered that it was impossible to determine whether the work could be done at berthing and disposal areas since no one yet knew how to decontaminate. In this same dispatch Commander Western Sea Frontier cited the fact that current directives failed to assign responsibility for decontamination and merely provided that representatives of Joint Task Force One would give advice as to precautions. Expressing concern lest the vagueness as to who was responsible for initiating yard work for radiological purification might have unfortunate consequences, he submitted the following specific recommendations:

(a) Assign highest priority to provision of technical staff for Captain Walsh.

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(b) Assign the Bureau of Ships the responsibility for developing practical methods for making ships radiologically safe and have Bureau of Ships deal with District Commandants and Shipyard Commanders in this matter through the normal chain of authority. Since problems are coastwise, Commander Western Sea Frontier should be responsible for coordinating district activities in this matter.

(c) Send Admiral Solberg or a similarly qualified line officer to the West Coast as representative of the Bureau of Ships to study the problem.

On the same day, the District Medical Officer of the Twelfth Naval District initiated a dispatch to Commander Joint Task Force One strongly recommending that Admiral Solberg with Bureau of Ships personnel assist in studying decontamination problems.

16. On 13 September the Chief of Naval Operations advised Commander Western Sea Frontier that the Bureau of Ships was charged with developing methods and equipment for decontamination of radiologically active ships and stated that this responsibility would require considerable time and liaison with Manhattan District to develop practical procedures. The Chief of Naval Operations also advised that Rear Admiral Solberg would arrive 17 September to discuss the problems, and authorized Commander Western Sea Frontier to assign restricted availability for shipyard work when required in connection with radiological clearance.

17. Meanwhile, some experimental work on decontamination was proceeding. Commander Western Sea Frontier had on 30 August directed the Commandant 12th Naval District to drydock one or more vessels of Destroyer Division 71, then present at San Francisco Naval Shipyard, in a floating drydock as "guinea pigs" for radiological monitoring as requested by the Radiological Safety Advisor, Joint Task Force One. Pursuant to this authority, LAFFEY (DD 724) was drydocked in Floating Repair Dock ARD 32 at San Francisco Naval Shipyard for radiological inspection on 5 September. The inspection was conducted under the supervision of Captain Walsh. Other members of the inspection party were Dr. Robert A. Newell, Stanford University, radiologist; Dr. F. H. Rodenbaugh, San Francisco, radiologist; Lt. Wayne A. Chadburn (MC) USN, special monitor. The inspection was also witnessed by representatives of the 12th Naval District and Commander Western Sea Frontier. Shipyard personnel assisted under the direction of Lt. Comdr. M. E. Turnbaugh, USN., Asst. Repair Supt. (Hull). Prior to the start of pumping operations, water

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around LAFFEY was tested for radioactivity with negative results. When pumping had been completed the ship's bottom was monitored and found to be below tolerance levels for gamma radiation. Samples of bottom scrapings were collected for laboratory analysis and for shipment to the Navy Department in Washington. Subsequent to the hull inspection, samples of scale were obtained by chipping scale from first effect tube nest of the forward engine room evaporators, also a cannister mask was worn during the chipping to provide a sample of solid material in the atmosphere which could be analyzed for possible presence of radioactive particles. As the next step, a section of four inch salt water piping was removed from the sea suction of the evaporator distiller pump for analysis at the University of California Radiation Laboratory. Monitor readings during the tests showed salt water lines to be more heavily contaminated than the underwater body, but still not to the extent of producing a radiation hazard to personnel. No positive results were obtained immediately from this inspection as conclusions were dependent on laboratory analysis. Elaborate precautions were observed throughout this operation to protect personnel against any possible hazard. These precautions included complete suits of special clothing, lectures of explanation enjoining personnel to avoid diligently contact with or ingestion of suspect materials, monitoring of personnel and clothing after completion of inspections, and provision of oxygen masks during chipping. As a precautionary measure, also, instructions were issued to wet down the outer hull of LAFFEY four times daily while in dock until the inspection board had granted definite clearance.

18. On 6 September, Captain Walsh advised the San Francisco Naval Shipyard that it would be satisfactory on WALKE, BARTON, LAFFEY and LOWRY to proceed with all repair and alteration work with the exception of that on the underwater body or any machinery in which radioactively contaminated salt water had been circulated. The Shipyard proceeded on this basis with work on all Bikini ships present, but held in abeyance all work on parts of ships touched by salt water of Bikini lagoon until monitors could be provided to inspect and issue specific precautions for each job depending on the conclusions reached on tests in hand. A "Changing and Decontamination Center" for yard workmen was set up at the Submarine Barracks with elaborate and complete clothes changing, lavatory, shower and eating facilities.

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19. On 12 September Captain Walsh arranged for a small section of the underwater body of LAFFEY to be sandblasted using the standard wet sandblast process. During the blasting there was set up on the skipbox carrying the sandblaster a Filter Queen to collect particles of dust in the immediate vicinity for analysis of radioactive matter contained and determination of the inhalation hazard. At the same time an electrostatic dust precipitator was set up on the floor of the dock near the test section for the same purpose. Subsequently, a section of radioactive, galvanized steel, salt water piping was unbolted from its location in the line and was burned through in a small closed compartment, with the Filter Queen again used to collect dust samples from the fumes to determine the respiratory hazard incident to burning pipe. These tests were attended by Dr. K. G. Scott from the Crocker Radiation Laboratory of University of California. Dr. Scott took all filters used to the Laboratory for analysis.

20. On 13 and 19 September, the filter tests of sandblasting operations were repeated but on a much larger scale using two 1000 c.f.m. blowers and collecting dust on filters made of heavily packed glass wool 2 inches thick. Also, on 14 September, at the request of Captain Walsh, a portion of LAFFEY's copper-nickel firemain was isolated for introduction of a solution developed by the Crocker Radiation Laboratory fro experimentation on the original section of evaporator line provided from LAFFEY. The solution was made of 25 gallons of water, 48 lbs. of acetic acid powder and 34 lbs. of ammonium hydroxide sufficient to reduce the acidity of the solution to pH 6.0. The section of firemain selected for the test was filled with the solution prepared, about 30 gallons being required, and allowed to stand for 72 hours. At the end of this period, the contents of the pipe section were blown by air into a barrel on the main deck. The solution discharged into the barrel showed radioactivity averaging about .01 R/day indicating that a large part of the radioactive material from the pipe had been removed from the line by the solution. One quart of the solution was taken by Dr. Scott for laboratory analysis. After evacuation of the decontaminating solution, the pipe section was flushed with fresh water and the discharge collected in a second barrel. The water showed no appreciable radioactivity, hence the discharge line was put over the side and flushing resumed and continued throughout the night. The treatment was successful in removing about 90% of the radioactivity, but did not dislodge any appreciable amount of marine growth.

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Geiger readings on the outside of the pipe before treatment ranged from .008 to .02, and on the inside from .05 to .5. After treatment, readings outside were from "background" to .007, and inside from .008 to .06.

21. Additional experimentation at Crocker Laboratory had indicated the possibility of using a dilute solution of hydrochloric acid for removal of marine growth and scale, and hence the contained radioactive materials, from piping systems. Consequently, on 17 September, a section of approximately 50 feet of copper-nickel firemain piping on LAFFEY was blanked off, fitted with hose connections, flushed with fresh water for 30 minutes, then a 1.08 normal solution of hydrochloric acid circulated through the section. Within a matter of minutes, the reservoir used for recirculating the acids showed the presence of radioactivity. The normality of the acid was checked periodically and found to decrease, then level off at about 0.45 normal after eight hours. Shortly thereafter, circulation was discontinued and the section under test was blown clear by air. Somewhat later, flushing with fresh water was commenced. Only the first barrel of flushing water showed radioactivity. Flushing was continued for one hour and ten minutes. The outside of the pipe was monitored and a second acid circulation phase commenced using a new mixture of 0.89 normal strength. This phase was continued for four hours and was followed by fresh water flushing for forty-five minutes. The hydrochloric acid treatment proved to be eminently successful having removed 98% of the radioactivity and all marine growth and scale from the pipe. Geiger readings on the outside of the pipe were .01 to .08 before treatment, .007 to .029 after the first phase and .001 or less throughout after the second phase. The inside of the pipe showed readings from .08 to .5 prior to treatment and .001 to .002 upon completion. This experiment was considered completely sucessful. Since the normality of the acid in the second phase of the treatment was not affected appreciably, it was concluded that this phase was unnecessary.

22. On 17 September, Rear Admiral Solberg, the Director of Ship Material, arrived on the West Coast for the purpose of conferring on conditions existing in non-target vessels and assisting in clarifying and developing procedures necessary to establish normal operating and upkeep conditions on these vessels. Admiral Solberg reported to the Commandant Twelfth Naval District and later to Commander Western Sea Frontier providing these two commands with all information

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available from Washington D. C., and outlining his proposed plans for accomplishing his objective. Admiral Solberg conferred with Captain Walsh, Radiological Safety Representative, and Dr. Scott of the University of California, at which time he was apprised of the type and laboratory results of the investigations conducted to date on the crossroads non-target ships at Naval Shipyard, San Francisco. After the conference he visited the San Francisco Naval Shipyard to witness experimental work and to discuss further experimental work and inspections to be accomplished to aid in establishing methods of handling each of the problems of the contaminated ships. The following are the highlights of plans and developments set forth by Admiral Solberg at the first Shipyard conference:

(a) Subject matter on how to rid a ship of radioactivity was to be classified "Top Secret".

(b) The Bureau of Ships would set up a "Decontamination Section" which would be interested in and would desire all information concerning experimental work being conducted at San Francisco.

(c) Information to date indicated that sandblasting of LAFFEY would be safe, and final decision in the matter would be given to the yard the following day.

(d) The Shipyard was to prepare for decontamination of BENEVOLENCE evaporators by acid cleaning. Final orders would be given after inspection the following day.

(e) The Shipyard was to prepare the following items for Admiral Solberg's inspection at 1300 on the following day:

(1) The two sections of the firemain of LAFFEY which had been cleaned, and adjacent sections for comparison in judging effectiveness of decontamination processes in removing marine growth.

(2) Evaporator on BENEVOLENCE open for examination for radioactivity; scale samples available for inspection.

(3) One auxiliary condenser open and a zinc available for examination.

(4) The Shipyard was to remove several salt water valves from LAFFEY for tests involving soaking them in decontamination solutions to determine whether this means was sufficient to remove radioactivity to the extent necessary to permit valves to be sent to shop for work without further radiological safety precautions.

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JOINT TASK FORCE ONE
DIRECTOR OF SHIP MATERIAL
U.S.S. WHARTON (AP7)

014K2/A20

14 August 1946

MEMORANDUM

Subject: Comments on Radiation Measurements on Target Submarines.

Enclosure: (A) Tabulation of daily Geiger readings.
(B) Curves of Radioactivity Decay for DENTUDA, TUNA, SEARAVEN, PARCHE and SKATE.

1. Daily topside readings of surfaced submarines were taken at about three feet above deck with a Geiger - Mueller counter at five selected spots. These readings were recorded in Roentgens per twenty-four hours and are tabulated in enclosure (A). Monitors taking readings and the instruments with which they were taken varied from day to day.

2. Trends indicated by curves plotted from the above-mentioned readings and pertinent information on the ships concerned is as follows:

DENTUDA - Had been submerged during Test Baker and was surfaced on Baker plus two. Ship is about a year and half old, paint is very thin and there is very little rust. Decontamination measures consisted primarily of topside scrubbing by ship's force using lye and boiler compound. The curve shows a rapid continuous rate of decay with a half life of about 2.5 days.

TUNA - Had been submerged during Test Baker and was surfaced on Baker plus two. Ship is old and has considerable paint and rust. Decontamination methods consisted primarily of topside scrubbing

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lines. Insufficient plutonium was deposited to be detectable on the measuring instruments available. This test indicated therefore that at least one thousand days of welding would be necessary for one individual to accumulate dangerous quantities of plutonium in his body. From all preliminary tests, it thus appeared entirely feasible to decontaminate and repair Crossroads non-target vessels without exposing personnel to radiological hazards.

26. On 18 September Admiral Solberg again conferred with Commander Western Sea Frontier and Commander Naval Shipyard, San Francisco on the overall aspects of the radiological decontamination problem. The high points of this conference were as follows:

(a) LAFFEY was to be considered an example of a ship with least hull contamination, having been in Bikini lagoon for only ten days subsequent to Test Baker and having plastic paint on the bottom.

(b) A ship having commercial underwater body paint and having been in the lagoon over the longest period subsequent to Test Baker would be considered as representing the case of maximum underbody contamination. This ship would be selected from available records, dry docked and the hull examined carefully. The data obtained would be compared with that from LAFFEY and would form the basis for decision as to whether all contaminated ships should be drydocked immediately or cognizant agencies merely notified to observe certain special precautions at the next normal docking period.

(c) Graving docks could be used for drydocking contaminated vessels.

(d) An additional burning experiment on highly radioactive piping was being planned for collection of fumes. This would represent the extreme case of this type, and analysis of the deposit together with data already available would reveal definitely any danger involved in working radioactive materials.

(e) The worst possible situation would be that complete decontamination by methods under development or similar would be necessary before work could proceed on suspect ships.

(f) The optimum situation would be that no decontamination would be required before working radioactive surfaces.

(g) Captain Walsh was to continue to issue "clearance for sailing" on the lines of existing policy.

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27. Following the conference, Admiral Solberg's party with interested yard personnel inspected experimental work on LAFFEY and BENEVOLENCE. Since the BENEVOLENCE evaporator scale showed more than twice the tolerance limit (0.1 R/day), it was ordered on the spot that cleaning be effected by the hydrochloric acid method previously standard in the Navy. Also, the No. 1 auxiliary condenser zincs showed high concentration of radioactivity, hence the ship was directed to replace all zincs immediately.

28. After the inspection trip, a broad program of immediate experimental decontamination work to be undertaken by the Shipyard was laid out. Details of this program and other experimental decontamination work undertaken are included in Appendix III. The general nature and results of the experiments will be discussed in a later section.

29. On 19 September, Admiral Solberg issued a memorandum to the Commander Naval Shipyard, San Francisco, specifying general test procedures to be followed in decontaminating all Crossroads non-target ships in the yard. It was directed that accurate records of all operations be kept by the Shipyard and copies furnished to the Bureau of Ships and Captain Walsh. A copy of this memorandum, together with subsequent directives of a similar nature, are included in Appendix IV. In general, the procedures specified were as follows:

(a) Salt water systems.

(1) Circulate ammonium citrate solution of predetermined strength through entire systems for approximately one hour.

(2) Flush with neutralizing solution of boiler compound and fresh water.

(b) Salt water piping system samples.

(1) Prior to cleaning, obtain samples of copper-nickel and iron piping about three inches long from salt water systems and test in three different concentrations of hydrochloric acid solutions: 1/2, 3/4 and 1 normal. Object of these tests is to determine effect of various solutions on cleaning marine growth, rust and other foreign matter from inside of piping. Make quantitative measurements of marine growth, rust and other foreign matter on the interior of the pipe before and during the testing.

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(2) Forward similar samples to Dr. Scott at the University of California.

(c) Heat transfer units and evaporators.

(1) On first cleaning, crack off all possible scale deposits by using thermal shock treatment.

(2) Remove scale using standard safety precautions.

(3) Complete removal of scale by using a muriatic acid solution.

(4) Have a monitor present at all times when opening up a unit in accordance with the above procedure.

(5) Segregate and dump at sea all scale removed.

(d) Ship's side in dry dock.

(1) Scrape all marine growth from ship's side keeping wet while scraping down.

(2) Clean from drydock, segregate and dump at sea all material scraped from ship's sides.

(3) Remove remainder of paint from underwater hull by wet snadblasting using standard equipment. Dump sand at sea.

30. On 20 September, Admiral Solberg informed Commander Western Sea Frontier of the conclusions thus far reached on the decontamination investigations and the proposed decisions for implementation in Washington. He then advised Captain Walsh of all investigations in progress or planned, and departed for Washington leaving two EDO officers, Captain W. S. Maxwell and Commander J. B. Shirley, to carry on the investigation work, and indicated the possibility of sending another officer, Commander E. J. Hoffman, from Washington to assist. On arrival in Washington, Admiral Solberg immediately proceeded with preparation of a directive covering the phases of decontamination which had been settled. This directive was issued as joint Bureau of Ships-Bureau of Medicine and Surgery Confidential Speedletter, Serial 1381, on 24 September. It included authority and directions for all contaminated ships scheduled to remain in the active fleet for decontamination of evaporators, heat transfer apparatus except condensers, underwater bodies and ships' boats.

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This letter also lifted the restriction on dry docking and repair of contaminated ships, requiring only that certain simple safety precautions be observed in directly handling contaminated materials or surfaces. A copy of this letter is contained in Appendix IV.

31. Serial 1381 was received with great enthusiasm by all commands concerned since it was the first specific indication that a solution to the problem was in sight, and it contained detailed instructions as to measures to be taken to clear ships of contaminating material. It also had the salutary effect of relieving the apprehension created by Commander Joint Task Force One Serial 079 as to the great and indeterminate hazard to which all personnel dealing with the suspect ships were liable to be exposed. It contained positive statements to the effect that routine repairs and operations could be undertaken without danger as demonstrated by actual tests. It also indicated that further information could be expected at an early date, particularly with respect to ships scheduled for disposal and inactivation.

32. Upon receipt of the new directive, work was started immediately to decontaminate ships in accordance with the instructions contained. Meanwhile Captain Maxwell proceeded to the Thirteenth Naval District to confer with the District Commandant and the Commander Naval Shipyard, Puget Sound to apprise them of the latest findings and procedures with respect to decontamination, and to interpret for them the new instructions. Shortly thereafter, Captain Maxwell proceeded to the Eleventh Naval District and Commander Shirley to Pearl Harbor for the same purpose. Appropriate safety precautions and instructions for prosecution of work on contaminated ships were promulgated immediately at these locations with the advice and information furnished by the Bureau of Ships representatives.

33. At the same time, the program of experimental decontamination work at Naval Shipyard, San Francisco set up by Admiral Solberg, looking toward improvement of methods and a greater fund of information on the subject, was prosecuted on a high priority basis. The following is a brief summary of the investigations in progress from 18 September to 1 October with the results obtained in each case. Appendix III contains detailed reports:

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(a) Evaporators on HENRICO and BENEVOLENCE were cleaned by circulating a solution of one normal hydrochloric acid and fresh water through the entire salt water system, draining and collecting used acid solution, neutralizing with a solution of boiler compound and water, then flushing thoroughly. On the first cleaning, on BENEVOLENCE, the level of the acid solution was carried in the shell only to the top of the tube nest. Inspection after cleaning revealed that a large quantity of scale remained in the top of the shell producing an average reading of 0.24 R/day gb.* The equipment was therefore rearranged to effect a complete washing process, filling shells completely, and the procedure repeated. This treatment was highly successful and all external readings were reduced to .01 R/day or less.

* gb - combined gamma and beta radiation.

(b) Two highly contaminated sections of the ferrous piping of the flushing system on HENRICO were selected for comparison of the effectiveness of hydrochloric acid solution and the ammonium citrate solution. One normal hydrochloric acid was circulated for twelve hours in the first section, 5.95 pH ammonium citrate for seventy-two hours in the second. Each section was given a thorough flushing subsequent to treatment. The readings in R/day obtained were as follows:

	Hydrochloric Acid		Ammonium Citrate	
	Before	After	Before	After
Outside Reading (g)	.003 - .02	Background	.002 - .014	.000 - .002
Inside Reading (gb)	.007 - .4	.002 - .008	.012 - .5	.003 - .08

The ammonium citrate was not effective in removing scale. The hydrochloric acid removed practically all scale and marine growth.

(c) Entire salt water systems of HENRICO and BENEVOLENCE were flushed with fresh water at high velocity for twelve hours in an attempt to determine whether the scouring effect of the water flow would remove activity. No measurable effect was produced.

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(d) Two short sections of contaminated fire main piping, one copper-nickel from LAFFEY and one ferrous from BOTTINEAU, were fitted with flanges and lines to permit steam, water or air to pass through. Steam was sent through each section until the outside temperature reached approximately 180° F. Immediately, cold water at 60° F. was run through the lines at high velocity. Under these conditions the temperature leveled off in about thirty seconds. The effect of the cold shocking operation produced reduction in maximum readings as follows:

	Copper-nickel		Iron	
	Before	After	Before	After
Outside (g)	.014	.003	.07	.003
Inside (gb)	.20	.06	.5	.01

All marine growth was removed from the copper-nickel pipe. The iron pipe had not been fouled, but was scaly. The scale was not affected appreciably.

(e) A 16" steel crossover line providing lower suctions for three auxiliary condensers on BENEVOLENCE showed external readings ranging from 0.1 to 0.9 R/day gamma which were too high to permit sailing to carry out the operational schedule. Two cold shock treatments, one to 170° F., and one to 195° F., were tried with no results. A 2 normal solution of hydrochloric acid was then circulated through the line for one hour and forty minutes, neutralized with soda ash solution and flushed thoroughly. The acid cleaning reduced readings to a range of .005 - .07 R/day. An interesting discovery made during this treatment was that tapping the pipe in the vicinity of highest readings was very effective in removing concentrations of radioactive material during the acid circulation.

(f) Several sections of contaminated copper-nickel and steel piping were treated with solutions of boiler compound and water as follows to determine the effect on radioactivity:

(1) Boiler compound and fresh water circulating for four hours.

(2) Boiler compound and fresh water standing in pipe for twelve hours.

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(3) Boiler compound and salt water circulating.
(4) Boiler compound and salt water standing.

None of the boiler compound treatments was effective in removing appreciable amounts of radioactivity.

(g) One contaminated section of copper-nickel salt water piping from LAFFEY and one of steel from BOTTINEAU were cut into 3'' test specimens for acid treatment. These specimens were immersed in solutions of 1/2, 3/4 and 1 normal hydrochloric acid, and 1/2 and 2 strength ammonium citrate buffer solution. (Single strength buffer solution is defined as 24 lbs. citric acid and 17 lbs. 28% ammonium hydroxide in 50 gallons of water. Two-strength is the same quantity of chemicals in 25 gallons of water). These showed that the 3/4 and 1 normal hydrochloric acid solution removed all scale, growth and activity in one hour. The 1/2 normal solution required three hours to remove all activity and still left considerable marine growth at the end of this period. The double strength buffer solution removed all activity and marine growth in 8 hours; the 1/2 strength solution removed only 80% of the activity and no marine growth in sixteen hours.

(h) Salt water system, copper-nickel valves of various sizes from LAFFEY were immersed in double strength ammonium citrate. The valves originally showed readings ranging from .008 to .29 R/day (gb). Although most of the activity was removed in one hour, four hours were required before every valve showed a maximum reading less than .01. At that time, readings ranged from .002 to .007 R/day (gb). A similar experiment with nine contaminated steel valves from BENEVOLENCE evaporator brine lines were dipped and scrubbed in a two normal solution of hydrochloric acid. The time required to reduce readings on these valves from .012 gb to background varied from ten to thirty minutes. There was no visible sign of attack by the hydrochloric acid on valves or valve seats.

(i) The entire salt water system of BARTON was filled with a double strength solution of ammonium citrate. Since the buffer solution experiments on LAFFEY had resulted in removing not all activity and only 30% of fouling after seventy-two hours, it was decided to extend the time on BARTON. Unfortunately, from the standpoint of the test, BARTON's salt water lines showed only a few significant readings, but she was the only vessel available for the test at the time. In order to obtain more complete information

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as to the effectiveness, however, twelve valves in the system were dropped for monitoring before and after the treatment. The maximum reading before the test was .084 R/day gb. The solution stood in the system for 90 hours and was drained. The system was then flushed thoroughly, neutralized with a soda ash solution and reflushed. All previous significant readings were reduced to background; the maximum internal reading at any check point was .007 gb., and all marine growth and scale with the exception of some barnacles in a few spots had been removed by the treatment.

(j) A series of tests was conducted to determine the extent of attack of the solutions being used for decontamination on metals commonly found in salt water systems on naval vessels. The specimens were 1/2 x 3" x 1/16" copper-nickel and medium steel strips, and 3" sections of admiralty metal evaporator tubes. The solutions used were 1, 2 and 5 normal uninhibited hydrochloric acid; 1, 2 and 5 normal inhibited hydrochloric acid; and 1/2, 1, 2 and 4 strength ammonium citrate buffer solution. The specimens were immersed in the various solutions at room temperature without agitation and weighed periodically to determine loss of metal. The results are plotted in detail in Appendix III. In general it was found that 5 normal uninhibited hydrochloric acid would cause medium steel to lose about one ten-thousandth inch of surface in approximately three hours, 2 normal in about five hours and 1 normal in about seven hours. Inhibited hydrochloric acid and buffer solution caused loss of one hundred-thousandth inch or less in six hours in all strengths and on all metals investigated.

34. On 26 September, as a result of the failure of the hydrochloric acid solution to be fully effective in cleaning evaporator shells when filled only to the top of the tube nests, Bureau of Ships Confidential Speedletter, Serial 1383, was promulgated. This speedletter modified the original directive Serial 1381 of 24 September by specifying that evaporators would be filled to as near the tops of the shells as practicable. In addition, stress was laid on adequate safeguards to insure that acid did not enter the fresh water system, and instructions were contained for neutralizing the evaporators by flushing with boiler compound solution and testing the fresh water system to insure that no acid had entered. This serial is included in Appendix IV.

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35. On the basis of the experimental work conducted at San Francisco Naval Shipyard and the University of California Laboratory, it was now apparent that it was entirely feasible and practicable to remove radioactive matter from the non-target ships. It was recognized of course, that considerable refinement of methods and techniques were indicated and that selection of best methods would be dependent on further experience and scientific investigation. The next most pressing need which arose, however, was establishment of a standard basis on which it could be determined when a vessel required decontamination and when it could be considered clear after decontamination methods had been applied. The nationally accepted standard of 0.1 R/day for continuous exposure of personnel to gamma radiation had been used as the standard for conduct of operations at Bikini and for restricting movements of personnel on contaminated non-target ships and returning ex-targets subsequent to the tests. Since that time, however, the revelation of the presence of alpha emitters with the fission products, the lack of instruments for detecting alpha emitters and the absence of standards for safe exposure to them had introduced an indeterminate factor in all deliberations as to radiological safety. It is true that a definite ratio of quantity of plutonium to millecuries of fission products present in any particular surface had been established, but the total quantity of alpha emitters to which an individual might be exposed on a ship over a long period of time was the determining factor in safety studies. No ready means for determining this quantity without extended investigations was apparent. Consequently, although .01 R/day had been selected as the arbitrary external radiation intensity below which all salt water systems should be reduced for clearance of active ships, no radiologists of recognized authority were ready to declare this figure safe until a study had been made of all factors involved. The University of California radiologists were of the opinion that the total quantity of fission products which should be considered safe for one ship would vary from 100 millicuries to one curie depending on the size of the vessel and the extent and distribution of the salt water system surfaces exposed to radioactive contamination. Some means would be required for conversion of radiation readings obtained on a ship to indicate whether the activity present was within these limits.

36. On 1 October, a conference was called by Bureau of Ships representatives in San francisco to discuss the means of establishing

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limits of radiological clearance of ships and standard procedures for decontamination. All interested agencies in the San Francisco area were represented. Arrangements were made at this time for a closely-knit organization consisting of representatives of the Bureau of Ships, Bureau of Medicine and Surgery, University of California and Naval Shipyard, San Francisco to collaborate on arriving at a solution to the problems with each discharging his own particular functions in an integrated effort. The Bureau of Ships designated ROCKBRIDGE as an experimental ship for the work. This ship offered and excellent specimen because she was the most heavily contaminated vessel to arrive in the area and was of sufficient size and proper type to provide a basis for broad studies of contamination measurement and systematization of decontamination procedures.

37. Complete instructions were issued to the Shipyard for work to be accomplished to permit the University of California to conduct an assay as to the plutonium present on ROCKBRIDGE. Work commenced promptly by drydocking the ship on 3 October. As the water was pumped down in the dock, the underwater body was carefully monitored. A 20 foot square area representing the heaviest radioactivity was selected and designated for a special test. The hull was then allowed to dry thoroughly in order to represent worst possible dust conditions. One foot square areas considered representative of the various conditions found on the hull were selected, carefully monitored, superficially scraped, remonitored, scraped to bare metal and remonitored. The materials thus removed were sent to the University of California Radiation Laboratory for analysis and use in estimating the contamination of the underwater body. Prior to scraping, the selected areas showed readings from .036 to .36 R/day. The designated test area was then sandblasted using regular wet sandblasting procedures. Two blowers with glass wool filters were used to collect as much of the dust as possible. One blower was placed next to the sandblaster and the other on the floor of the dock below. The sandblasting reduced all readings in the test area to background values. The sand on the floor of the dock read .002 - .005 R/day. Samples of the sand together with the filters from the blowers were taken to the University of California for analysis. It was intended that analysis of the filter samples obtained would provide information as to the worst respiratory conditions which might be expected in sandblasting the hull dry without prelimin-

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ary removal of marine growth. It also was planned to find the total amount of plutonium present on the underwater body by assays of scrapings of representative hull areas and of samples of the sand used in sandblasting.

38. During this period studies also were being conducted at the University of California to determine whether hydrochloric acid was effective in removing alpha emitters as well as the fission products detectable by the geiger counters, and to establish optimum concentrations of acid solutions for use in decontamination work. Research had already revealed that ammonium citrate would take up in solution many fission products and plutonium by offering greater attraction for them than did the marine growths and calcareous structures (phosphates and carbonates) and the rust (hydroxides). With the hydrochloric acid solutions, however, the action consisted of dissolving the calcareous materials and rust which contain the radioactive products rather than taking into solution the products themselves. The acid underwent a chemical change in this operation forming new soluble compounds with the carbonates, phosphates and hydroxides, and liberating carbon dioxide gas. The end result was the same as with the citrate solution, in any case, since the material containing the activity was in solution or suspension and was removed when the acid solution was drained and the system flushed. When using ammonium citrate, a solution of sufficient strength had to be used to compete with the quantity of carbonates, phosphates and hydroxides present. Consequently, it was recommended that full strength solution (24 lbs. citric acid and 17 lbs. ammonium hydroxide to 50 gals. water) be used on ferrous lines and double strength solution (same chemicals in 25 gals. water) on copper-nickel lines. In the use of hydrochloric acid care had to be exercised to insure that sufficient strength of solution was used to avoid complete neutralization which might cause the active materials to reprecipitate. It definitely should be understood that in all cases the treatments used did not affect the radiations emitted by the fission products and plutonium, but merely removed them from the areas affected.

39. The results of the investigations revealed that hydrochloric acid was equally as efficient as ammonium citrate in removing fission products and alpha emitters from salt water systems. Since the

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inhibited hydrochloric acid was found to attack shipboard materials at about the same rate as the citrate, there was much to recommend the former as the standard decontamination solution. It is more thorough in removing scale and marine growth, it requires much less time to do a complete job (4 hours against 72) resulting in a lesser overall attack on metallic surfaces and saving of time, and the chemicals required are cheaper and more readily available. The principal disadvantage of the hydrochloric acid is the industrial hazard incident to its use which, however, requires only simple and well known precautionary measures.

40. In order to determine the practicability of using hydrochloric acid as a decontaminating agent for an entire ship's salt water system, a 1 normal solution was circulated through the fire and flushing system of WALKE for four hours. The system was then drained, neutralized and flushed thoroughly. The outside readings, which had been as high as .07 R/day, were with only one exception reduced to less than .01 R/day, and in most cases, including pumps and valves, radiation readings were decreased to .001 R/day or less. In addition, the operation had been carried out without undue difficulty. The decision was therefore made to use hydrochloric acid as the standard decontamination material in continuing the experimental work on ROCKBRDIGE.

41. Subsequent to the sandblasting and procurement of samples on the controlled area of the underwater body of ROCKBRIDGE as outlined above, additional samples of barnacle scrapings from eighteen square feet of hull, marine growth from six square feet, and rust from six square feet also were obtained in order to make a calculation of the total quantities of these materials on the underwater body. Finally, the entire remainder of the exterior underwater hull was sandblasted completely and the sand used was sampled statistically and sent to the University of California for assay in connection with the calculations of the total amount of plutonium on the ship. As the next step in the process, all salt water systems in ROCKBRIDGE were completely and carefully monitored throughout. The systems were opened up and samples of the foreign matter obtained at fourteen high reading locations in the fire and flushing system, and at three locations in the evaporators. At each sampling location measurements of the amount of foreign material present and the area represented thereby were determined. Finally, the total areas of all

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parts exposed to sea water in and on the ship were calculated carefully. The areas calculated included evaporator plant, main and auxiliary condensers, fire and flushing system complete, cooling system and lubricating oil coolers, and exterior hull. All these data, together with the samples obtained, were forwarded to the University of California Radiation Laboratory.

42. The entire firemain and flushing system, excluding the refrigeration cooling system, was filled with a one normal solution of hydrochloric acid. The solution was introduced from a 500 gallon mixing tank through the numbers one and two fire and flushing pumps and recirculated by leading a hose from an after fireplug back to the mixing tank. The circulation was continued for three and one-half hours after the system was completely filled, following which the system was flushed with fresh water, neutralized with a solution of trisodium phosphate and reflushed thoroughly with fresh water. Following this decontamination, a complete remonitoring survey was conducted and the results sent to University of California. Similarly, a 1.4 normal solution of hydrochloric acid was circulated through the evaporators for about four hours, followed by flushing, neutralization and reflushing. As in the case of the fire and flushing system, complete monitoring surveys were conducted before and after cleaning. Monitoring results together with samples of the decontaminating liquids utilized were sent to the University of California. The decontamination processes conducted on ROCKBRIDGE were successful in removing about eighty percent of the radioactive material from the fire main and flushing system and reduced the evaporators to background except for a few isolated spots which required detailed treatment.

43. The data obtained from the ROCKBRIDGE studies were considered sufficient to provide information as to the approximate total quantities of fission products and alpha emitters on board. Since ROCKBRIDGE was known to be one of the most heavily contaminated non-targets, it was assumed that data regarding the actual amount of contamination together with full monitor readings would enable establishment of firm limits for radiological clearance of all non-target vessels. Upon completion of procurement of the necess-

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ary basic information, however, it became obvious that the amount of radiochemical analysis entailed by the project and the limited facilities available for the work at the University of California signalled a period of weeks before final results could be presented. Meanwhile the number of ships released from Crossroads was growing rapidly and many of these vessels could not carry out their operational schedules until clearance had been granted. It must be remembered, also, that no work whatever had been authorized as yet for decontamination of the suspect vessels scheduled for inactivation or disposal. This fact was delaying release of crews and prosecution of necessary work preparatory to assigned disposition. It was apparent therefore that the earliest possible establishment of some standards of clearance and instructions for complying with them was essential. The Bureau of Medicine and Surgery had been charged with the responsibility for assessing radiological hazards and setting safety tolerances by the Chief of Naval Operations in a directive establishing the Navy's radiological safety program on 27 August. (See Appendix IV). However, the Bureau of Medicine and Surgery was helpless because that agency had been able to obtain no safety standards for this type hazard either from previous experience of others or from current investigations. All decisions were based on opinions from the group of radiologists on the West Coast under the guidance of Captain Walsh, the JTF-1 representative. As stated above, Drs. Hamilton and Scott had expressed themselves verbally on several occasions as being of the opinion that .01 R/day would be an acceptable standard for maximum exterior radiation from salt water lines or machinery below which no decontamination would be required, but were not willing to go on record officially as to the safety of this figure until further data became available. It was admitted at the time, however, that the tentative figure mentioned was intentionally low because of consideration of the slight possibility that a large portion of the contamination remaining might accumulate in one spot and thereby produce a hazard, and also because gamma and beta indicators decayed so much more rapidly than alpha emitters that cleaning should be undertaken immediately while easily read indicators were present.

44. On 10 October, the Bureau of Ships addressed a dispatch to Captain Walsh proposing limits for final radiological clearance and decontamination of all non-target vessels including those scheduled

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for inactivation and disposal. The recommended limits were briefly as follows: (All readings in R/day: g = gamma, gb = combined gamma and beta).

(a) Enclosed in metal or other shielding media.

Final clearance - all readings .01 g. or less.

Clean soon as practicable - 25% or less of readings .01 - 0.1 g.

Clean immediately - more than 25% of readings .01 - 0.1 g or any area exceeds 0.1.

(b) No shielding media interposed.

Final clearance - all readings .02 gb. or less.

Clean soon as practicable - any readings .02 - 0.1 gb.

Clean immediately - any areas reading in excess 0.1 gb. except that underwater hull need not be decontaminated until next scheduled docking.

The dispatch also proposed acid cleaning all evaporators as a precautionary measure regardless of radiological condition and proposed omission of sandblasting of underwater body at first scheduled docking if all readings were less than .02 R/day gb. Captain Walsh was requested to discuss the proposed limits with Drs. Hamilton and Scott and to submit specific recommendations.

45. On 11 October, Captain Walsh, after conference with Dr. Hamilton, submitted the following recommendations by dispatch:

(a) Closed systems such as evaporators, salt water systems, heat exchangers, etc., (external readings).

(1) Final Clearance:

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Active ships .01 g or less.

Inactive and Disposal Ships .001 g or less.

(2) Clean soon as practicable:

All ships where up to 25% of readings 0.01 - 0.1 g.

(3) Clean immediately:

All ships where over 25% of readings 0.01 - 0.1 g or any section exceeds 0.1 g.

(b) No shielding media as on hull:

(1) Final Clearance:

Active Ships .05 gb or less.

Inactive and Disposal Ships .005 gb or less.

(2) Clean soon as practicable:

All ships with readings 0.05 - 0.5 gb.

(3) Decontaminate immediately:

All ships any area reading over 0.1 g (except underwater body).

(c) Underwater Body.

(1) No sandblasting but remove fouling using wet technique:

All ships with all readings .05 gb or less.

(2) Sand blast at first scheduled docking:

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All ships if readings exceed 0.05 gb.

(3) Sandblast immediately:

All ships where readings taken on inside of hull exceed 0.1 g.

As an item of information, Captain Walsh's dispatch advised that the lower limits were recommended on inactive and disposal ships for medico-legal and security reasons.

46. The Bureau of Medicine and Surgery was opposed to acceptance of the two standards of clearance proposed by Captain Walsh. The basis of the argument on this point was the fact that ships currently scheduled for the active fleets might at a later date be transferred to inactive or disposal status. A change in status of this nature would require that vessels so transferred be reduced to tolerance levels established for ships scheduled for inactivation or disposal.. Since this change might take place long after the gamma and beta indicators had decayed beyond the level of detection by readily available instruments, the only method remaining by which alpha contamination could be determined would be difficult and extensive sampling and radio-chemical analysis. In view of this fact, the Bureau of Medicine and Surgery considered that final clearance standards must be the same for all ships and that any preliminary clearance granted active ships and considered acceptable for normal operation and repair but not for inactivation or disposal, must be recognized as such. Therefore, it was ruled that final clearance maximum allowable readings for all ships would be .001 R/day gamma for shielded readings and .005 R/day combined gamma and beta for exposed surfaces pending further developments.

47. It was obvious to the Bureau of Ships that reduction of all readings on salt water systems even to .01 R/day gamma would require decontamination of almost every non-target which had been exposed more than one day in the lagoon after test Baker. Those which had been exposed only one day were found to be within the limits of .001 R/day and were granted final radiological clearance immediately along with all vessels which had not entered the lagoon subse-

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quent to Test Baker. From the success of experimental work to date in decontamination at San Francisco, it was considered that sufficient experience warranted the adoption of the best methods already developed as standard for all ships requiring decontamination. Consequently, the Bureau of Ships, with the concurrence of the Bureau of Medicine and Surgery, promulgated a dispatch on 14 October (141550Z, copy included in Appendix IV) authorizing the ship's force of all non-target vessels, including those scheduled for disposal and inactivation, to proceed immediately with acid cleaning of evaporators in accordance with previous letters, and also one acid cleaning of the entire firemain, flushing, cooling and drainage systems, including pumps, coolers and other heat transfer apparatus except condensers. The solution prescribed was about 1.1 normal, inhibited hydrochloric acid in fresh water. As an additional measure, boiling out of the salt water sides of main and auxiliary condensers with boiler compound was prescribed in accordance with the procedures set forth by the Bureau of Ships Manual for cleaning the steam sides of condensers. In the dispatch also were included statements to the effect that special protective clothing was not required for work on non-target vessels and the only real restriction was avoidance of skin contact with radioactively contaminated surfaces. The reason for stressing this point lay in the fact that considerable confusion still existed in many minds as to how much protection was required for personnel on the non-targets. This matter had not been amplified sufficiently in the original directive.

48. On the basis of authority contained in the dispatch of 14 October, necessary decontamination work was initiated by ship's force in the majority of the Bikini non-target vessels not already granted final clearance. About fifty-five of the ships involved had arrived on the West Coast and work proceeded as well as might be expected considering the fact that personnel were dealing with an entirely new field. Many questions as to details of application to particular ships arose. To answer the inquiries and requests for indoctrination, the Bureau of Ships maintained officer representatives on the West Coast constantly. These officers visited from time to time all industrial activities and type commanders who were handling contaminated vessels as the need arose for clarification of details. The specialist officers so assigned were sorely pressed to find time to provide sufficient details to all ships seeking information. The need for a detailed directive was apparent, but it was desired not to promul-

gate a general document of this nature until clearance limits had been established and until prescribed procedures had proved definitely satisfactory in a number of cases. It was considered that premature issue of information which required considerable revision at a later date would possibly harm the program more by engendering confusion than would instruction of ship crews by only a few officers well familiarized with the problem and the investigations in hand, and who were in close contact with the Bureau of Ships. The need for detailed written instructions was alleviated partially by preparation and distribution of the most up-to-date information on approved decontamination methods by the Bureau of Ships representatives to vessels arriving on the West Coast.

49. In order to permit further development of decontamination methods, provide further information as to nature and extent of contamination on various types of vessels exposed in Bikini lagoon, and to make available further data as to quantities of radioactivity and fission products on board non-target vessels, ACHOMAWI (ATF-148) and LST 881 were ordered to Naval Shipyard, San Francisco for experimental decontamination. It was anticipated that controlled monitoring and cleaning of these vessels, combined with careful sampling, would produce data required to supplement findings on ROCKBRIDGE. Preliminary data from the studies on ROCKBRIDGE were becoming available and it was already obvious that data obtained were incomplete in many cases and in general were indicative only of the worst conditions to be found in the ship. Hence, they were of doubtful value for integration in an effort to determine accurately the total quantities of fission products or plutonium aboard. In general, however, the experimental work at San Francisco had decreased considerably and greater emphasis was being placed on accomplishment of decontamination by methods already developed pending final outcome of the ROCKBRIDGE studies.

50. The lack of designation of a military authority charged with responsibility of actual prosecution of decontamination work on the non-targets had not been remedied. Consequently, the Bureau of Ships requested the Commander in Chief Pacific and Commander Western Sea Frontier to direct ships under their operational control to apply the authorized measures as soon as possible and compatible with operational schedules. Most of the work with the exception of drydocking was

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within the capacity of ship's force. Controlled experiments in complete decontamination by ship's force at sea were conducted in the San Francisco area and were most successful. Some limited assistance was required in obtaining acid mixing tanks and miscellaneous items of equipment to accomplish the acid circulation. This aid was provided for by the Bureau of Ships in authorizing any Naval industrial activity to expend up to one thousand dollars per ship in rendering essential shipyard services to vessels in accomplishing decontamination work. A section had been established as Code 180-A under the Director of Ship Material in the Bureau of Ships to coordinate and provide necessary technical direction for decontamination and clearance of ex-Crossroads vessels. This section was made up entirely of officers who had participated in the material aspects of the Bikini operations and who were thoroughly familiar with the radiological problems involved and the methods developed to combat them.

51. Although considerable inertia was usually experienced at the outset, the decontamination program by ship's force on the West Coast gradually swung into action. Many of the ships with the assistance and guidance of the various groups organized for the purpose were meeting with considerable success in removing radioactive material from the salt water systems. On the advice of Captain Walsh, the limits originally recommended to the Bureau of Medicine and Surgery for final clearance of active ships were adopted as the temporary standard for "operational", "conditional" or "preliminary" clearance as it was variously termed. In order to relieve obvious confusion as to the implication of this type of radiological clearance, the Bureau of Ships defined it as clearance for all normal operations, maintenance and repair subject only to the previous restrictions imposed on skin contact with radioactive surfaces and exposure to dust from dry abrasion. It was recognized that final clearance limits could not be definitely fixed until the data from ROCKBRIDGE assays had been compiled.

52. In addition to the establishment of criteria for determining when vessels had been decontaminated completely, two outstanding gaps appeared in the decontamination processes thus for authorized. The first was the question of establishing when underwater body decontamination was necessary and the second was the development of

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an effective method for removing activity from condensers. Boiling out of condensers with boiler compound solution had yielded negligible results. With respect to underwater bodies, the Bureau of Medicine and Surgery was not convinced that the recommended limit of .05 R/day gb for clearance of the exposed exterior hull below the water was compatible with the .005 R/day gb recommended for other exposed surfaces. The Bureau of Ships, on the other hand, was desirous of developing some means of determining without drydocking whether the underwater hull required decontamination. The docking of vessels was an expensive and time consuming operation which should be eliminated entirely, if possible, without violating safety or security considerations.

53. The first preliminary reports of the results of the ROCKBRIDGE assays conducted by the University of California indicated that the total quantity of fission products present was just about a tolerance dose if the samples taken were considered as representative of conditions over the entire bottom. This conclusion was most encouraging to the Bureau of Ships since some of the samples taken had read as high as 0.4 R/day and the average was about 0.2 R/day. This finding, if confirmed, would eliminate the necessity for underwater body decontamination of most if not all of the non-target vessels. How to determine without drydocking whether a vessel met the prescribed conditions, however, was not readily apparent. Two possible schemes were devised. The first was correlation of readings inside the hull with conditions of radioactive contamination existing outside. This, however, proved to be impracticable because of the low order of activity being dealt with. The second possible solution lay in listing the ships and monitoring carefully the portion of the underwater body thereby exposed. It was known from experience on hulls already drydocked that the radiological conditions on the underwater hull in the vicinity of the waterline were generally representative of the worst conditions found anywhere on the underwater body. Immediate steps were taken, therefore, to have suspect vessels in all ports of the West Coast listed and monitored at the waterline. The encouraging aspect of the underwater contamination was the established fact that the plastic types of paint did not contain more than trace quantities of fission products. All of the contamination resided in any marine growth and rusty or scaly patches present.

54. Representations were made to the Bureau of Medicine and Surgery to decide whether the method of determining the condition

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of the underwater body of the suspect ships by listing and monitoring portions of underwater bodies thus exposed would be satisfactory for clearance purposes. That Bureau did not desire to render a decision on any matter involving ship clearance without further advice on each question by a competent board of radiological advisors. On 25 October the Bureau of Medicine and Surgery consequently authorized establishment of a special medical advisory board to counsel the Chief of the Bureau of Medicine and Surgery on radiological matters. (See Appendix V). The board consisted principally of recognized radiologists and radioactivity toxicologists: Drs. Hamilton, Scott Rodenbaugh, Newell, and when available, Drs. Langham and Stafford Warren. Captain Walsh was designated chairman and Lieutenant (jg) Morton as recorder of the Board. The duty assigned this Board was to consider and make recommendations to the Surgeon General of the Navy on radiological matters specifically presented to it for study. The first series of problems presented dealt with the many aspects of radiological clearance of ships which had been matters of controversy during the preceding weeks.

55. The Medical Advisory Board to the Chief of the Bureau of Medicine and Surgery held its first general meeting on 4 November. At this conference the data from ROCKBRIDGE studies were made available to members of the Board. On the basis of this information and after considerable discussion, the following general final clearance limits were recommended: (All readings R/day, g = gamma, gb = combined gamma and beta.

Shielded

Active Ships .01 g max.

Inactive and Disposal .001 g max.

Unshielded

Active Ships .05 gb max.

Inactive and Disposal .005 gb max.

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Underwater Body

Active Ships .05 gb.

Inactive and Disposal .02 gb.

In addition, the Board made the following comments:

(a) When readings are below tolerance except for one localized area on hull, each case to be considered on its own merits.

(b) For evaporators and pipes, all sections should be cleaned to below tolerance except sections outboard of the sea valves which should be considered part of the hull.

(c) More experience is required before a statistical average of readings with no single area above a certain intensity can be specified as satisfactory from the standpoint of quantitative degree of radioactive contamination of a ship.

(d) On the basis that ROCKBRIDGE underwater body is the worst to be expected, recommend that tolerances specified be met prior to granting clearance.

(e) Waterline readings are considered of no value as an indicator of the general condition of the underwater body. They may be of value if ships are heeled over. It is recommended that an attempt be made to correlate internal and external hull readings from experience gained on ships drydocked.

(f) The X-263 is unsatisfactory for reliable readings below .01 R/day, but is the best available instrument and can be used if calibrated on known radium sources.

56. The Bureau of Medicine and Surgery immediately took exception again to the application to active ships of radiological clearance standards differing from those specified for inactive and disposal ships, because of the possibility of change in ultimate assignment as discussed previously. The Bureau of Ships declared that it was not practicable nor considered necessary to decontaminate the entire salt-water system of a ship to the prescribed standard of .001 R/day for external radiation readings. There was also considerable question as to the interpretation of .02 R/day as the limit for underwater body clearance; i.e., whether this was a maximum or statistical average and whether readings were to be taken with hull wet or dry.

[redacted]

57. The University of California report on the investigations conducted on ROCKBRIDGE ~~had estimated~~ that there was sufficient plutonium on the ship to constitute several tolerance doses. The findings indicated ~~that most of the~~ radioactivity was in the salt water piping systems. "The quantity of plutonium estimated on the underwater body from the samples analyzed would constitute about a tolerance dose if concentrated. In this case, however, the material is so widely distributed in tons of rust, scale, paint, marine growth and other matter that it would represent a remote security and a negligible physiological hazard. Further, when removed by sandblasting, the plutonium would be mixed with some 125 tons of sand and would present absolutely no hazard of any type. The report on the ROCKBRIDGE was recognized as representing the integration of worst conditions throughout the ship, and the Bureau of Ships did not consider it representative of the actual conditions on this or any other ship and argued that it should be taken in that light when establishing clearance limits. The Medical Advisory Board apparently had used the report as an example of what might be expected on a ship with monitor readings on the order of those on ROCKBRIDGE and recommended final clearance limits accordingly. The report had many discrepancies and points requiring clarification. The Bureau of Ships took immediate steps to insure that a more exact determination of fission products on board and proper coordination with radiation readings would be obtained from the assays to be conducted on ACHOMAWI (ATF-148) and LST 881. It was realized, however, that it would be many weeks before these data could be made available and that the ROCKBRIDGE report would have to be used as authorative until further information of a positive nature was forthcoming.

58. Dispatches were sent concerning some of the questions arising on the Medical Advisory Board recommendations, and a Bureau of Ships representative, Commander J. J. Fee, USN, proceeded to the West Coast to discuss the matter further. After additional study and consultation with the Bureau representatives, the Board revised its recommendations for final radiological clearance of all ships as follows, all readings in R/day corrected to 1 October 1946:

(a) For all units which are habitually closed, shielded readings as follows:

[redacted]

(1) Ninety-four percent of ship's salt water system not exceeding .001 gamma.

(2) Five percent of salt water system not exceeding .005 gamma.

(3) One percent of ship's salt water system not exceeding .01 gamma.

(b) Open systems limited to average .001 gamma and .005 combined beta and gamma.

(c) Underwater body, statistical average of readings systematically taken not exceeding .02 combined gamma and beta wet or dry on portions of underwater body exposed by listing and trimming to maximum practicable extent.

The Board at this time advised the Bureau of Ships that the desirability of one set of standards for all ships had been recognized, but that two categories had been recommended originally in an attempt to effect early release of active ships for operational purposes. The Board considered that the amount of activity allowable for active ships was much greater than for ships being scrapped and that active ships later designated for scrapping could meet disposal standards at a later date if required.

59. The Bureau of Medicine and Surgery accepted the revised recommendations for final clearance, and established the operational or preliminary clearance standards at the values recommended previously by the Board for active ships. These limits were accepted by the Bureau of Ships as workable and it now became possible to put ship clearance on a sound basis and to advise vessels specifically what additional cleaning would be required to meet standards. The final step lay in furnishing to all ships involved a general detailed directive including clearance procedures, clearance limits and detailed instructions for decontamination of each part or system of a ship showing radiation intensities exceeding tolerance levels.

60. During the period of controversy regarding clearance standards, further experimental work on removing radioactivity from main and auxiliary condensers was carried out at Naval Shipyard, San Francisco. The circulation of 1/2 normal hydrochloric acid solution was tried in several auxiliary condensers and proved effective in

[redacted]

condensers which were copper-nickel throughout. The treatment removed only about 50% of the activity in condensers which had dissimilar metals in heads, tube sheets and tubes. Because of the heavy deposit of scale and rust on the heads in the latter type it was necessary to submit them to more thorough treatment. After several variations in methods it was found that the most efficient general method of cleaning lay in submitting the entire condenser first to a one-half normal acid treatment for one hour, then opening up and cleaning manually in detail any parts remaining above tolerance. The manual cleaning consisted in the main of wire brushing thoroughly the inside of the heads with a one-normal acid solution, punching the tubes with a rag and rod, removing all scale and sludge and flushing down thoroughly. This treatment had no ill effects on the condenser materials and was considered satisfactory for adoption as standard. The use of acid in main condensers was not considered acceptable because of the large size and the possible damage from electrolytic action between dissimilar materials. Main condensers in most cases were contaminated only lightly, and removal of zincs followed by detailed manual cleaning of heads, tube sheets and tubes, removal of sludge and scale, and thorough flushing proved satisfactory.

61. Upon completion of the experiments on condendensers and the establishment of clearance limits, the Bureau of Ships representatives on the West Coast prepared a complete set of proposed instructions for decontamination of all parts of non-target ships found radioactive beyond clearance limits, and detailed safety precautions to be observed in the work. These were returned to Washington, some additional data included by the Bureau of Medicine and Surgery and issued jointly on 22 November by the Bureau of Ships and Medicine and Surgery. A copy of the letter is included in Appendix IV. This letter superseded all previous instructions and served as the established doctrine for radiological decontamination and clearance of all remaining contaminated Crossroads non-target vessels.

62. Using the ship clearance and decontamination procedures established by the letter of 22 November, the ship's force of all contaminated vessels, except those prevented by operational requirements from doing so, continued with decontamination in accordance with the established doctrine. At this time many vessels already had

[redacted]

been cleared. At each opportunity radiological monitors made surveys of the parts of ships not yet cleared and requiring decontamination and forwarded reports of findings on forms provided. Operational clearances were granted as rapidly as possible by Commander Western Sea Frontier and final clearances by the Bureau of Ships and Bureau of Medicine and Surgery upon reduction of readings to specified limits. By 1 January 1947, a total of 80 vessels of the 159 non-targets had been granted final radiological clearance, and work was progressing faborably on most of the remainder.

63. In many cases the prescribed circulation of the hydrochloric acid solution was not completely effective in reducing radioactivity to tolerance levels in all parts of salt water systems. Particular difficulty was encountered in dead ends of piping systems or where circulation was poor, such as in by-passes at reducer stations. Some trouble was also experienced in firemain gate valves where valves were installed with bonnets down allowing silt, rust and marine growth to be pocketed in the bonnets where acid solution circulation could not remove it. The ultimate success in all cases of this nature depended on the energy and initiative of the ship's force. Where general circulation failed, the obvious solution to the problem was removal and manual cleaning of the part involved, or isolation of a particular section for detailed acid solution treatment.

64. On 27 November, a conference was held in the Bureau of Ships for the purpose of discussing the overall situation with regard to safety and security of the radiological decontamination procedures on the Bikini non-target ships. Attending the conference were representatives of Bureau of Ships, Bureau of Medicine and Surgery, Manhattan Engineering District, and Dr. J. G. Hamilton of the University of California, J. G. Crocker Radiation Laboratory. The conclusions reached at the conference were as follows:

(a) There is absolutely no possibility of physical injury from radioactive materials in the amounts being dealt with on the non-targets under existing conditions.

(b) The possibility of the use of radioactive materials removed from non-targets as a source of plutonium need be of no concern because it is much easier and simpler to produce larger amounts by use of small cyclotrons which are more readily available.

[redacted]

(c) The principal question of security lies in the possibility of determining bomb efficiency by analyzing radioactive products removed from ex-Crossroads vessels. When decontaminated to existing limits for final radiological clearance the only possible source for this analysis would lie in materials removed from the underwater body. Even this was considered to be impossible, but Dr. Hamilton agreed to conduct analyses of these materials to determine whether successful determination of efficiency by this method was possible. Manhattan security personnel agreed that, pending receipt of information to the contrary, underwater bodies of non-targets cleared according to existing standards would be considered as presenting no security hazard.

(d) Special disposal of sand used in sandblasting underwater bodies of radioactively contaminated non-target ships is not required, provided marine growth is removed first and disposed of.

(e) Solutions used in removal of radioactivity from salt water systems of non-target ships may be discharged into harbors, preferably at a slow rate or after dilution, without security or health hazard.

The minutes of the conference are included in Appendix V. The information regarding disposition of sand-blasting sand and decontaminating solutions was promulgated to all interested commands and appropriate corrections to the procedure letter of 22 November were issued. Included also in this correction, which is contained in Appendix IV, were approved recommendations of the Medical Advisory Board that small boat hulls, anchor chain, anchors and chain lockers be subject to the same limits for final radiological clearance as were underwater bodies of non-target ships.

65. On 18 December, information from tests conducted at the University of California revealed that the decay rate of gamma radioactive material had been found much more rapid than was originally realized. The tests revealed that readings taken on 1 December 1946 to be corrected to 1 October 1946 would require application of a factor of two. This was of considerable importance since the required factor had been calculated previously as 1.1 - 1.2, and had been neglected because it was within the range of error of the instruments used. Many ships had thus been granted final radio-

[redacted]

logical clearance when application of proper factors would not have justified it on the basis of established clearance limits. The matter of clearance limits was immediately restudied by Dr. Hamilton of the University of California. His studies on the basis of current information indicated the following:

(a) Limits could be raised considerably without incurring a health hazard.

(b) If geiger counter readings were corrected to 1 January 1947 and existing limits for final clearance maintained, no security hazard would arise.

Existing instructions were modified immediately to require correction of monitor readings to 1 January 1947 for clearance purposes. At the present time it appears that all non-target ships will have received final clearance by about 15 March 1947.

66. The following conclusions are submitted as a result of the experience gained in dealing with radiological conditions on the Crossroads non-target vessels:

(a) Vessels steaming or anchored for even limited periods in sea water containing radioactive atomic fission products will have radioactive materials deposited on all surfaces exposed to the contaminated water. The quantity of fission products deposited will vary with the concentration of radioactivity existing in the sea water, the length of exposure and the physical and chemical properties of the surfaces exposed. The radioactive products deposited will be concentrated principally in exposed matter of vegetable origin, porous surfaces, rust, scale, marine growth and paints other than intact, plastic antifouling paint.

(b) Deposits of radioactive material on shipboard surfaces represent a potential physiological hazard to personnel in two possible ways depending on the quantity and concentration of the fission products.

(1) External radiation effects may be suffered from gamma rays for a variable period by personnel habitually in the vicinity of concentrations of radioactive materials.

[redacted]

(2) Internal radiation effects may be experienced by personnel who permit extensive ingress of long-life fission products to their bodies through cuts and abrasion in their skin, or by breathing or otherwise ingesting large quantities of dust generated from radioactively contaminated surfaces.

(c) Natural decay will eliminate personnel hazard from external radiation in a period of time varying from a few hours to several months depending on the degree of concentration. Natural decay does not, however, remove the danger of the long life fission products whose toxicity depends on their introduction into the body.

(d) Application of special fission product removal techniques is required to eliminate from radioactively contaminated surfaces the early gamma radiation hazard and the long-life fission product toxicity danger. The nature and extent of the external physiological hazard produced by gamma radiation is reasonably well defined and readily assessible by available field instruments. The toxicity resulting from the absorption or ingestion of a given quantity of alpha emitter fission products by the human body is not known with any degree of certainty, nor is the ratio of the alpha emitters retained by the body to the quantity introduced. Further, there is available at present no ready means of determining easily and quickly in the field the concentration of alpha emitters in a radioactively contaminated surface.

(e) After two months experimental work, methods were developed which were successful in removing deposits of fission products to the extent necessary to eliminate all health and security hazards from this source. The methods adopted are not suitable for effective field application in early and rapid removal of radioactive contamination since they are slow, tedious and require quantities of material and equipment not ordinarily carried on board naval vessels.

(f) For purposes of national security it is considered necessary that an extensive program of radiological research and development be carried out with the following objectives:

(1) Develop methods of reducing or eliminating deposits of radioactive materials on ship components exposed to water containing products of atomic fission.

[redacted]

(2) Develop on a high priority basis means of removing or neutralizing rapidly in the field fission product deposits immediately after an attack utilizing atomic fission.

(3) Develop positive information as to the toxicity from introduction of a given quantity of long-life fission products into the human body by various means, the manner in which such quantities can be introduced, and means for detecting readily the existence and concentration of alpha emitters in any contaminated area.

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PART III

FUTURE RADIOLOGICAL DECONTAMINATION RESEARCH PROGRAM

1. Early findings of the Crossroads Tests indicated without question that one of the most important and far reaching effects was the contamination of the participating targets by deposits of radioactive materials on the ships and the radiological effects resulting therefrom. As pointed out in Section I of this report, the contamination by alpha emitters, whose concentration can be determined positively at the present time only by elaborate and lengthy radio-chemical analysis, necessitated that attempts to rehabilitate the ships at Bikini be abandoned because of the potential physical hazard involved. Very little was known at the time or, indeed, at this writing, as to the radio-physiological effects of continuous exposure of personnel to the radioactive products on the targets. The same applies to the means of protecting personnel working on ships heavily contaminated, or methods of removing rapidly general concentrations of radioactive materials from ships.

2. The implications of radiological effects on ships exposed in the vicinity of fission of an atomic bomb brought out by the Bikini operations were tremendous. Here was revealed the possibility of killing or disabling, permanently or temporarily, by a single bomb large numbers of men on naval vessels at a distance of three or more miles from the point of fission. Furthermore, large numbers of ships could be rendered unsafe for habitation for indeterminate periods under present standards of ship design and with the present status of knowledge as to the behavior of radioactive products of the bomb. It was clear that a research program of indeterminate scope, but certainly extensive, to obtain and analyze carefully all possible radiological data on the Crossroads target vessels and to develop counter-measures and defense procedures was necessary for future national security.

3. On 27 August 1946, the Chief of Naval Operations promulgated a directive (See Appendix IV) establishing the Navy's Radiological Safety Program. Among other items, the Bureau of Ships was charged

[redacted]

in the program with the responsibility for and cognizance over individual and collective protection of shipboard personnel from radiological effects; development of decontamination measures and distribution of decontamination equipment; and development, procurement and distribution of adequate detection instruments. To implement the research program required to discharge the responsibilities assigned to the Bureau of Ships with respect to the Radiological Safety Program, arrangements were made for the return of many of the surviving Crossroads target vessels to Naval Shipyards for radiological studies and other purposes, while several other vessels were scheduled for indefinite retention at Kwajalein for the same purpose. The present plan of geographical disposition of the targets involved is as follows:

SAN FRANCISCO

INDEPENDENCE	(CVL 22)
CRITTENDEN	(APA 77)
GASCONADE	(APA 85)

BREMERTON

PENSACOLA	(CA 24)
SALT LAKE CITY	(CA 25)
HUGHES	(DD 410)

MARE ISLAND

CONYNGHAM	(DD 371)
SKIPJACK	(SS 184)
SKATE	(SS 305)

PEARL HARBOR

NEW YORK	(BB 34)
NEVADA	(BB 36)

KWAJALEIN

MUGFORD	(DD 389)
MAYRANT	(DD 402)
RHIND	(DD 404)
STACK	(DD 406)
BRISCOE	(APA 65)
BRULE	(APA 66)
DAWSON	(APA 79)
FALLON	(APA 81)
YOG 83	

4. To coordinate the radiological investigation of target vessels and to provide a centralized agency staffed with adequate scientific personnel and furnished with proper equipment to conduct necessary radiological research and development work, the Bureau of Ships directed, on 18 November 1946, that a Radiation Laboratory be established at Naval Shipyard, San Francisco. A copy of the

[redacted]

directive establishing the Laboratory is included in Appendix VI. The Laboratory was charged under the Bureau of Ships with making provisions for estimation of radioactive contamination, development of methods and procedures for decontamination, studies of contamination by radioactive materials and allied investigations. The facilities so established were designed to supplement and cooperate with activities of the Naval Establishment having direct cognizance of other phases of the radiological safety program. Arrangements were made at the outset for use of the facilities of the Laboratory by the Bureau of Medicine and Surgery for making studies of physical radiological hazards and such work in connection therewith as is associated with decontamination. The Bureau of Yards and Docks and the Bureau of Aeronautics also expect to utilize the facilities of the Laboratory in connection with their problems and responsibilities in connection with radioactivity and radiological safety.

5. The first projects of the new Radiation Laboratory involved studies of the decontamination and final radiological clearance of the remaining non-target vessels. More extensive and complete research work was contemplated for the returning target vessels. The first prospectus of work on these ships was issued on 14 January 1947. A copy is included in Appendix VI. As originally contemplated, the Laboratory will play the major part in portions of the investigation of the returning targets dealing with deposits of radioactive materials on the ship, radiological hazards and decontamination.

6. At the present writing the Radiation Laboratory at Naval Shipyard, San Francisco has just commenced functioning and time has not yet permitted development of extensive information. It is anticipated, however, that the Laboratory will render invaluable assistance in solving future problems involving the use of atomic energy and radioactive materials in warfare and for industrial purposes.

[redacted]

APPENDIX I

REPORTS OF TARGET VE[illegible]

DECONTAMINATION

APPENDIX I

FOREWORD

1. The ships' forces which were engaged in decontamination work aboard are as follows:

U.S.S. SALT LAKE CITY (CA25)
U.S.S. NEW YORK (BB34)
U.S.S. NEVADA (BB36)
U.S.S. PENNSYLVANIA (BB38)
U.S.S. PRINZ EUGEN (IX300)
U.S.S. CARTERET (APA70)
U.S.S. WAINWRIGHT (DD419)
U.S.S. CONYNGHAM (DD371)
U.S.S. MUGFORD (DD389)
U.S.S. PARCHE (SS384)
U.S.S. DENTUDA (SS335)
U.S.S. TUNA (SS203)
U.S.S. SKATE (SS305)
U.S.S. SEARAVEN (SS196)

The U.S.S. NIAGARA (APA87) is not included as an example of orthodox decontamination but rather because of the interesting nature of the ship's contamination which necessitated rather different procedures. The following ships found similar conditions and took more or less similar measures upon reboarding and rehabilitating their vessels.

U.S.S. CORTLAND (APA75)
U.S.S. GENEVA (APA86)
U.S.S. BLADEN (APA63)
U.S.S. FILLMORE (APA83)

The ships' reports that are included herein are typical ones and selected on account of the phases of rehabilitation reached. The SALT LAKE CITY had removed most of the numerous "hot" spots and was just about ready to start general decontamination. The U.S.S. NEW YORK had a start on general decontamination. This ship was fortunate in having relatively few excessively radioactive areas to reduce. The U.S.S. WAINWRIGHT made extraordinary good progress toward rehabilitation.

[redacted]

CA25/49-7 U.S.S. SALT LAKE CITY 15-che

Serial: 225

19 August 1946

From: The Commanding Officer.
To: The Commander Task Group 1.2.
The Director of Ship Material.

Subject: Report of Radiological Decontamination of the U.S.S. SALT LAKE CITY (CA-25).

References: (a) CTG 1.2 despatch 171836 of August 1946.
(b) DSM verbal request of 16 August 1946.

Enclosures: (A) Report of Radiological Survey - Post-Baker (nine (9) pages).
(B) Diagrams of main deck and communication deck showing radiological areas (six (6) pages). (Not available)

1. The first efforts at decontamination were begun on 2 August. Thorough cleaning and removal of paint could not be accomplished until 6 August when cleaning materials became available. Four monitors assigned to work with the ship conducted surveys about the ship to determine hot areas the first two days to facilitate the removal of the hot areas first.

2. On 5 August a complete survey was begun and readings on representative areas were recorded. Each day the same route was followed and readings recorded to determine changes. Enclosures (A) and (B) are the results of this survey. Many localized hot areas which were quickly removed are not shown in the record in all cases since they were located by other monitors checking over areas to be worked. Each day new "hot spots" were discovered which were not previously known to exist.

[redacted]

U.S.S. SALT LAKE CITY

15-che

CA25/49-7

Serial: 225

19 August 1946

3. On 5 August a strong acetic acid solution was applied to a deck area on the open bridge to determine the value of acid in decontamination. The 4 ft. square area was scrubbed for 5 minutes after acid was applied then flushed off. A control area of the same size was also scrubbed for 5 minutes using only salt water. Both areas were reduced exactly the same amount (1.5 R to 1.3 R).

On 6 August a similar solution of Hydrochloric Acid was applied to a steel plate and scrubbed for several minutes then flushed off. No control area was used but the results were very nearly the same as for the acetic acid.

On 7 August a piece of the wood deck was removed from the well deck after measuring the radiation of the area. The section was then brought to the ROCKBRIDGE and planed down with a joiner machine by 1/16 inch cuts. 5/16 inch was removed to bring the wood to tolerance. A special report of the experiment was submitted on 8 August.

4. Every effort was made to prevent anyone from receiving more than the established radiation tolerance. It was found necessary to continually caution men about precautions to be taken around hot areas and still some would be found handling debris with bare hands although rubber gloves were available. Men were worked in groups with one petty officer to every 5 or 6 men. It is considered highly impractical to work the SALT LAKE CITY with great numbers of men and remain within safe radiation tolerance without competent petty officers assigned to each small group of men (5 or 6 men).

5. The following is a summary of work accomplished each day.

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U.S.S. SALT LAKE CITY

15-che

CA25/49-7

Serial: 225

19 August 19

<u>2 August</u>

A few personnel boarded the ship from the CONSERVER which was moored alongside and sprayed boiler compound and lye solution on bulkheads, the top of turret #1 and the steel deck on the forecastle. Small parties threw numerous pieces of shrapnel overboard from weather decks. Entire ship was hosed down by CONSERVER for about 30 minutes. Average radiation 3 to 4 Roentgen on weather decks except forecastle which averaged about 2 R before work was begun. No readings were taken upon securing.

<u>3 August</u>

Boarded with two parties of 50 men each in 2 hour relays.

Scrubbed forecastle, communication deck and well deck with sand and soap. No other cleaning materials were available. Forecastle readings reduced to 1 R, with steel deck about .5 R.

<u>4 August</u>

Boarded with 3 parties of 50 men each in 2 hour relays.

Holy stoned forecastle with soap and sand. Flushed coral sand (highly radioactive) from open bridge, pilot house level, communications deck and entire main deck. No other cleaning materials were available. Open bridge and pilot house reduced from about 12 R to 4 R average. Some drains and puddles remain high but were removed later.

<u>5, August</u>

Boarded with 3 parties of 50 men each in 2 hour relays.

Cleared away wood gratings, bunting and other debris from open bridge, scrubbed deck and hosed it down thoroughly. Scrubbed

[redacted]

U.S.S. SALT LAKE CITY

15-che

CA25/49-7

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19 August 1946

pilot house level, communication deck and flushed down. Flushed down well deck, after superstructure deck and main deck aft. No caustic cleaning materials were available. Average readings on bridge and pilot house reduced to 2.5 to 3 R and communication deck to about 2 R.

<u>6 August</u>
Boarded with 3 parties of 50 men each in 2 hour relays.

Sprayed lye solution on bulkheads and deck of open bridge, pilot house level, turret #1, communication deck and forecastle deck. Flushed off lye solution after scrubbing with deck scrubbers, removing several coats of paint from painted surfaces. Readings generally reduced 10 to 15% on wooden deck. Painted surfaces reduced 25 to 35%.

Removed vent cover port side, frame 100, main deck. Reading outside--60 R, reading inside--100 R. Flushed out vent with hose. Reading reduced to 8 R.

<u>7 August</u>
Boarded with 3 parties of 50 men each in 2 hour relays.

Holy stoned main deck from forecastle to well deck. Sprayed lye solution on bulkheads from turret #1 to the well deck. Lost electric power at 1400. Unable to washdown scrubbed decks.

Cleaned out contaminated newspapers and canvas from wing storage frame 60. Readings reduced from 48 R to 4 R.

Cleaned out debris from spud locker and flushed out. Reading reduced from 32 R to 10 R high with about 5 average.

[redacted]

U.S.S. SALT LAKE CITY

15-che

CA25/49-7

Serial: 225

19 August 1948

8 August

Boarded with 2 parties of 80 men each in 3 hour relays to reduce time lost in changing working parties.

Completed flushing loose paint from areas where solution was applied previous day.

Solution had to be reapplied to remove paint. All bulkheads and turrets in forward half of ship were completed. Commenced spraying and flushing of bulkheads on after superstructure deck. Considerable paint was removed although reduction in general radiation was about 10%. Where paint collected in puddles around drains on communication deck reading increased from 1.5 R to 5 R. Puddles were removed.

9 August

Boarded with 2 parties of 80 men each in 3 hour relays. Removed hot debris from after searchlight platform. Removed pockets of hot sand and debris in airplane crane structure and around structure abaft after stack.

Removed paint with lye solution from turret #3 and #4, secondary conn structure and gun shields, on after superstructure deck. Slight reduction in radiation apparent although a complete survey was not made after completion of work and the ship was not again boarded for the regular daily survey conducted each morning.

J. CONNOR

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U.S.S. SALT LAKE CITY

CA - 25

REPORT OF RADIOLOGICAL SURVEY - POST BAKER

Monitors: Lt. Cdr. SKOW (Sr. Off.)
Lt. Cdr. SMITH
Lt. Cdr. ELDRIDGE
Lt. HUFF
Lt. WELLS
Lt. (jg) ROUTT

Note: All readings are stated in Roentgens / 24 hours

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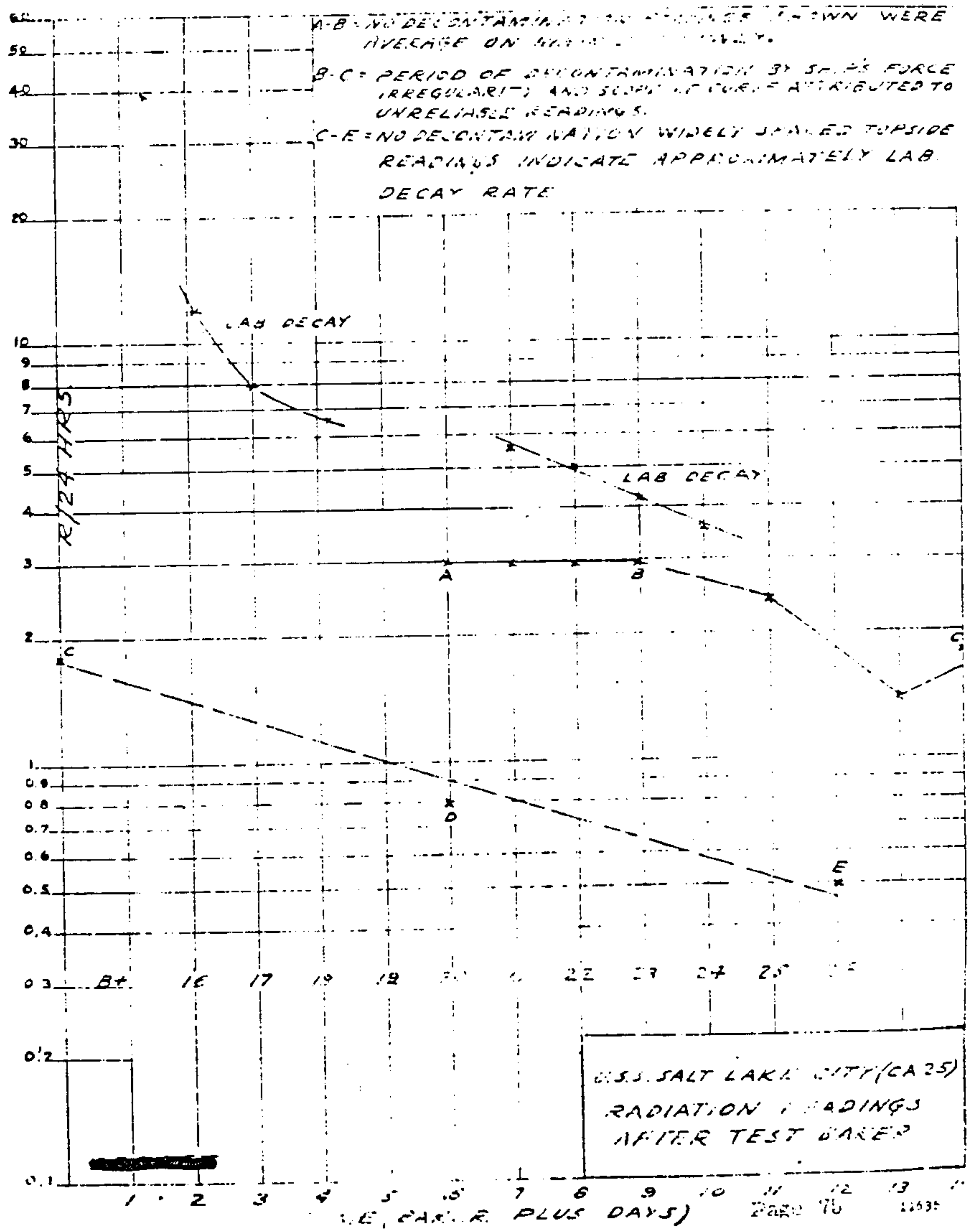
A-B = NO DECONTAMINATION ... WERE AVERAGE ON ...
B-C = PERIOD OF DECONTAMINATION BY SHIPS FORCE IRREGULARITY AND SLOPE OF CURVE ATTRIBUTED TO UNRELIABLE READINGS.
C-E = NO DECONTAMINATION WIDELY SPACED TOPSIDE READINGS INDICATE APPROXIMATELY LAB DECAY RATE
LAB DECAY
LAB DECAY
R/24 HRS
A
B
C
D
E
B+
16
17
19
22
24
25
U.S.S. SALT LAKE CITY (CA 25)
RADIATION READINGS AFTER TEST BAKER
PLUS DAYS)

11635

Main Deck and Superstructure:

	August 4	5	6	7	8	9
Water in aft. stbd. corner of wardroom	1.0	0.6	removed..........			0.3
Water in passage to Captain's Country	2.0	1.5	1.5	1.3	1.0	0.7
Landing to ComDeck stbd. side.	1.0	2.0	1.5	1.0	1.0	0.8
ComDeck aft - aver.	3.0	2.0	2.0	2.5	1.5	1.2
No. 3 5'' sponson ave.	2.0	1.5	1.0	0.7	0.7	0.6
Water in #3 sponson	1.0	3.0	removed.......................			
No. 1 5'' spon-ave.	3.0	1.0	1.2	0.8	0.8	0.7
Water in #1 sponson	3.5	3.0	3.0	1.1	0.85	0.8
ComDeck - stbd. of Turr. #2 - deck average	1.5	1.5	1.2	0.9	0.9	0.7
Turret #2 stbd. bulkh'd	0.5	0.5	0.5	0.4	0.35	0.3
ComDeck - port aver.	1.0	1.5	1.0	0.7	0.8	0.5
ComDeck - port - aft of Turret #2	2.0	2.0	1.7	1.2	1.2	1.0
Radio I bulkh'd - port	1.0	1.0	1.0	0.57	0.4	0.4
No. 2 5'' sponson	2.0	2.0	1.0	1.5	1.0	0.5

Main Deck and Superstructure:

	August 4	5	6	7	8	9
ComDeck, hatch to Capt's Country	1.0	1.0	1.0	0.7	0.8	0.5
No. 4 5" sponson	1.5	1.0	1.0	1.5	1.3	0.5
Water in #4 sponson	3.0	2.0	2.0	removed...............		
Drains in #2 sponson						
Stbd. aft	15	15	12	8	4	7
port aft	3	4	4	2	1.5	2
Drain head of ladder to pilot deck, port	15	15	10	5.5	5.5	5.0
Pilot Deck - port	12	3	3	3	3	4
Inside pilot house deck average	1.5	1.0	0.2	0.2	1.5	0.15
Pilot Deck, stbd. 20mm	15	15	8.0	1.0	1.0	0.7
Pilot Deck, stbd. aver.	20	4	3	2	2	2
Bridge, stbd. 40mm	6	2	2.0	0.9	0.9	0.7
Deck aft of Nav. Bolth	10	3	3	2.5	1.0	0.9
Open Bridge, fwd	15	3		2.5	1.5	0.7
Open Bridge, port	8	4	2	2.4	1.1	0.9
Bridge, port 40mm	3	2	2	2	0.58	0.6

[redacted]

Main Deck and Superstructure:

	August 4	5	6	7	8	9
Radar Xmtr. deck port aft drain	20	20	20			14
Radar Xmtr. port-deck	4	4	4			3
Radar Xmtr. stbd-deck	6	6	6			6
Landing to ComDeck port side	2.0	1.5	1.5	1.0	1.2	0.9
Deck port of W.R.	1.0	1.5	1.0	0.9	0.6	0.4
Deck port of Turret #1	1.5	0.8	0.7	0.7	0.5	0.4
Focsl. port, wood	1.0	0.6	0.5	0.6	0.4	.35
Focsl. port, metal	0.4	0.4	0.3	0.5	0.3	.25
Eyes	0.3	0.3	0.2	0.4	0.2	.15
Focsl. stbd. metal	0.4	0.2	0.2	0.3	0.3	.15
Focsl. stbd. wood	0.8	0.5	0.4	0.5	0.4	.15
Deck fwd. of Turret #1	1.0	0.5	0.6	0.4	0.4	0.4
Stbd. of Turret #1 deck	1.2	0.8	0.7	0.6	0.5	0.4
Stbd. bulk'd Turret #1	1.8	0.4	0.4	0.4	0.4	0.3
Deck at Bos'n Locker	2.5	2.0	1.2	0.8	0.8	

[redacted]

Main Deck and Superstructure:

	August 4	5	6	7	8	9
Deck stbd. of W.R.	1.0	0.8	0.7	0.7	0.4	0.4
Quarterdeck, average	2.0	1.5	1.4	1.2	1.0	0.8
Deck outside metal shop	2.0	2.0	2.0	1.2	1.0	1.0
Stbd. passage deck	1.5	1.2	1.2	1.0	1.0	1.0
Stbd. boat stowage	10	2.0	2.0	2.0	1.5	4.0
Deck outside CIC aft	3.5	2.0	2.0	3.5	1.5	1.5
Deck frames stbd. 110-120	2.0	1.5	1.2	1.1	0.8	0.7
120-130	1.5	1.0	0.8	0.7	0.6	0.7
Metal deck 40mm	1.2	1.0	1.0	0.7	0.7	0.6
Wood fantail fr. 140	1.5	1.0	0.7	0.7	0.7	0.6
Charcoal on fantail	2.5	2.5	2.5	2.5	2.0	2.0
Deck frames Port 130	2.0	1.0	0.9	0.7	0.7	0.5
120	1.2	1.0	1.0	0.7	0.7	0.5
110	1.2	1.0	1.0	1.1	1.0	
Chafing mattresses	more than 15		2.0........		2.0	3.0
Gutter frame 110 P	000	1.5	1.5	1.8	1.5	
Gutter frame 105 P	80	2.0	2.0	2.0	2.0	

[redacted]

Main Deck and Superstructure:

	August 4	5	6	7	8	9
Laundry vent cover	150	90	60	10	6.0	6.5
Port boat stowage	60	2.0	2.0	2.0	2.0	2.5
Deck about Messhall hatch	3.0	3.0	1.5	0.9	0.6	1.0
Port passage deck	3.0	1.0	1.0	1.4	2.0	1.2
Spud cleaner deck	10	15	15	32	10	6
drain outside	20	10	10	4	4	3
Port side well deck	2.0	1.0	1.0	1.2	1.0	.55
Well deck amidships	6	5	4	4	4	3.5
Deck at stbd. ladder	20	2	2	2	0.6	1.0
Port side aft of W.R.	2.0	1.5	1.5	1.5	0.8	.65
Ward room deck averg.	0.2	0.2	0.2	0.2	.15	.03
Door maindeck fr 109 S		10	10	8		
Galley		1.9	1.5	1.5	1.5	1.2
Wing stowage		20	20	48	4.0	2.5

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	August 7	8	9	10	11	12
Paint locker	.06	.06	clear........................			
Anchor windlass	.048	.048	clear........................			
Room 202	.048	.048	clear........................			
201	.036	.036	clear........................			
203	.036	.036	clear........................			
204	.072	.072	clear........................			
206	.06	.06	clear........................			
205	.036	.036	clear........................			
207	.048	.048	clear........................			
208	.060	.060	clear........................			
F10-30 passageway	.036	.036	clear........................			
F20 linen locker	.036	.036	clear........................			
F23 port blower	.036	.036	clear........................			
F23 port head	.084	.084	clear........................			
Room 210	.072	.072	clear........................			
209	.084	.084	clear........................			
Dark room	.060	.060	clear........................			
F29 heater room	.060	.060	clear........................			

[redacted]

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	August 7	8	9	10	11	12
Room 212	.048	.048	clear........................			
F37 head	.007	.007	clear........................			
Room 214	.072	.072	clear........................			
213	.017	.017	clear........................			
211	.024	.024	clear........................			
Troop Off. bunk rm.	.036	.036	clear........................			
Room 215	.009	.009	clear........................			
217	.009	.009	clear........................			
F40-48 crews space	.036	.060	forward area clear.........			
MAA shack (inside)	3.0	2.0	2.0			
MAA shack (outside)	4.0	4.0	2.2			
F48 center line	1.5	1.5	0.8			
F48 port	2.0	2.0	2.0			
Compt. at F48 port	0.2	0.2				
Blower at F48 port	0.45	0.45				
Blower at F48 stbd.	0.6	0.6				
F49 port crews head	0.45	0.50				
stbd crews head	0.5	0.5	0.4			
Fwd. edg fwd. uptake	1.3	1.3	0.8			

[redacted]

	August 7	8	9	10	11	12	13
F52 stbd. hatch to B.R.	2.0	2.0	1.5				
1st lts. office	.060	.060	.040	clear....................			
Post office	.060	.060	.040	clear....................			
F62 stbd grating to BR	8.0	2.0	2.0				
Eng. office		1.0	.06				
Center fwd. uptake	1.5	10.0	3.0				
Fwd. uptake stbd.	8.0	8.0	7.0				
Water at oil shack	12	10	12				
F61 port blower room	3.0	4.0	3.0				
Fwd. uptake port	4.5	10	6.0				
Rec. Hall	.4	.4	.3				
Barber shop	.084		.036	clear..................			
F72 stbd door	2.0	1.0	0.8				
F72 port door	.14	.10	.60				
Electric shop	.10		.30				
F78 port head	.08		.03				
shower	.80		.03				

[redacted]

	August 7	8	9	10	11	12	13
F78 uptake (port)	10	10	5				
(center)	20	20	10				
F78 port blower	1.5		4.0				
F86 machine shop	4	4	4				
stbd.	1.5	1.1	.5				
Mimeograph room	.24						
Mess hall port fwd.	.2	.2	.2				
mid	.4	.3	.4				
aft	14	.3					
Hatch to ice room	1.0	1.0	1.5				
Mess Hall stbd. fwd	.5	.5	.5				
mid	.6	.6	.6				
aft	1.5	1.5	1.5				
center	.5	.4	.4				
F80 machine shop	.2	.2					
Light shop	.1		.06				
Machine shop (inboard)	.8		.8				
Shipfitter's compt.	.08	.15					
F109-113 port	.072	.060	clear...........................				
stbd	.096	.08	clear...........................				
F113-119 port	.060	.060	clear...........................				
stbd.	.060	.060	clear...........................				

[redacted]

	August 7	8	9	10	11	12	13
F119-126 port	.017	.01[illegible]	clear..........................				
stbd.	.06	.05	clear..........................				
CPO mess port	.06	.06	clear..........................				
stbd.	.06	.06	clear..........................				
F132-140 port	.14	.0[illegible]	.4				
stbd.	.19	.09	.4				
Aft head	.012	.05	.06				

[redacted]

this symbol / stands for "less"

	August 6	7	8	9
15		0.1		
20		0.1		
27		.072		
29 Sick Bay	.05	.06	.04	
G.U. ward	.036		/ .1	/ .1
Dental		.036	.036	/ .1
P.R. steril		.048	.036	/ .1
O.A. outer bulk'd		.072		/ .1
Disp. window		.060		/ .1
Dis. outer bulk'd		.072		/ .1
GSK annex		.048	.024	/ .1
37 Passageway		.048		/ .1
GSK issue		.048	.036	/ .1
Small stores		.048		
48 A-310 stbd.	0.14	0.10		
A-310 center		0.52		
A-310 port	0.19	.072		

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	August 6	7	8	9
42 Diesel pump		.048		
Laundry	.14	.30		
1-4			.072	
4-10			.048	
Sail locker			.048	
15-18 Linen closet			.072	
18-23 Fresh water			.048	
A-607-A			.24	
A-506-A			.048	
Medicine locker			.036	
23-28 port			.036	
Sick Bay head			.036	.036
Third Deck				
28-30 Sick Bay Ward			.048	/ .1
Lab.			.036	/ .1
44-48 stbd. aft			.084	/ .1
port aft			.048	/ .1
Fire room #1		.072	.060	/ .1
Fire room #2 (near burner 1)		.072	0.60	/ .1

[redacted]

Third Deck

	August 6	7	8	9
Fwd. engine room 4th deck	.072		.036	/ .1
3rd deck			.14	/ .1
Fire room #3	.072		.084	.08
Fire room #4	.072		.034	.08
Aft engine room 3rd deck	.11		.06	.06
4th deck	.11		.60	.06
Ice room			.048	
Long shaft alley port			.060	
100 D-401 M			.036	
After gyro room			.036	
Long shaft alley stbd.			.024	
100-109 port and stbd.			.060	
109-119 port and stbd.			.048	
119-130 port and stbd.			.060	
130-138 port storage			.060	
stbd. storage			.060	
138-141 storage aft			.036	

[redacted]

UNCLASSIFIED

BB34
Serial 221

U.S.S. NEW YORK [illegible]
[illegible]
[illegible]

15 August 19[illegible]

From: The Commanding Officer.
To : The Director of Ships Material.

Subject: Report of Decontamination Progress, U.S.S. [illegible]

1. Following completion of washing down procedure by the tug on the afternoon of 6th August, first decontamination teams from the ship's company boarded on the 7th. These teams were relieved every two hours and returned to the ROCKBRIDGE. The day was spent mainly in jettisoning useless, highly radioactive material such as canvas, cargo nets, battered topside lockers, wood items and debris of all sorts. All life-rafts and floater nets were put overboard and secured to the side of the ship. Preliminary inspection of the ship, especially in the suspected flooded areas, were made by the Commanding Officer, together with the First Lieutenant and Carpenter. Engineering Department started the forward diesel generator for emergency light and power, and the forward diesel fire-pump, preparatory to furnishing water to wash down the main deck. Casualty power circuits were run to fuel oil service pump in #2 fireroom and to the submersible pumps being rigged aft, preparatory to pumping. C and R Department spent day making complete inspection of the fire-main and rigging the P-500 pump and submersible pumps so that pumping of flooded areas could be commenced first thing on the 8th. As water could not be obtained on deck until completion of inspection of the fire-main, decontamination could not start in earnest on the forecastle until sufficient working materials could be assembled. One group, in charge of a Chief Pay Clerk, spent the day scouting for boiler compound, lye cornstarch, scrubbers, gloves, boots, and the like. Fresh water was hauled from the ROCKBRIDGE. By early afternoon water was obtained from the fire-main and the topside was washed down, particular attention being paid to the forecastle.

UNC[illegible]

[redacted]

BB34 Serial 221 15 August 1948

2. On the 8th of August, since necessary working materials were now assembled, decontamination on the forecastle began in earnest. Solutions of boiler compound and lye were used - lack of fresh water being a handicap, - and the forecastle was washed down several times. Sand was obtained and holystoning began. Cleaning up of the second deck was also started and numerous pools of water removed, debris cleaned up and loose gear that had been knocked about straightened up. The jettisoning of useless gear continued. The Engineering Department had started the forward diesel generator and diesel fire-pump for fire-main pressure. The diesel generator was connected to main distribution board through #12 fire-pump feed in order to supply power to the submersible pumps and to #3 fuel oil service pump. At 0900 fires were lighted off under #3 boiler and steam formed at 0950. At 1100 steam was cut in to the forward dynamo and #2 turbo generator warmed up. Pumping was commenced in the engine room, shaft alleys and storeroom bilges. At 1120 completed checking essential electrical circuits and at 1130 shifted electrical local from #1 diesel generator. At 1230 commenced pumping D-12 through secondary drain and flooded after diesel generator room through man-hole and opened gravity drain to port engine room bilges. Started pumping bilges. The C and R Department meanwhile was pumping aft with two submersible pumps in trunk D-38 and one pump in the C.P.O. mess room. Procedure was to work aft from D-38 to flooded steering gear room and steering room.

3. On August 9th forecastle was again washed down and holystoned with boiler compound, lye and sand. Fresh water still had to be hauled from ROCKBRIDGE in cans. Approximately 100 men were turned to on the second deck and considerable progress was made in cleaning up the second and third decks and officers' country. Others turned to cleaning up forward superstructure levels. General Field Day was held on the second and third decks, in the forward superstructure, and in the engineering spaces. Engineering Department washed out ice box, cleaned refrigeration plant and made ready for operation. Cleaned out boot shop. Started sick bay air conditioning unit. Ventilation system,

[redacted]

having been cleared by Radsafe, had previously been started. Drained after diesel fire pump and generator; tried to jack over by hand and found both frozen. Completed stripping forward group of fuel oil tanks. Replaced air casing on #1 boiler that was blown out on Test Baker. Cleaned up evaporator room and machinery; port set ready for operation. Washed down radioactive surfaces in the port engine room and blower room with boiler compound. Checked circuits to fresh water pumps and started same. Fresh water from the reserve feed bottoms cleared by Radsafe. Sent to Radsafe sample from fresh water gravity tank. C and R Department completed pumping D-112, D-38, D-37, D-35, and started pumping D-32. Both boat cranes were found to be operable and both planes were jettisoned.

4. On August 10th, forecastle was again holystoned with boiler compound, lye, and sand. Air castle and boat decks were washed down with boiler compound and lye, and the main deck aft washed down with salt water, preparatory to giving these decks the same treatment given to the forecastle. Engineering Department continued Field Day and Gunnery Department commenced decontamination of test torpedo and mine. C and R Department pumped out D-25, D-27, D-26-P, and D-26-S. Open seams found in D-12 and D-13, after trimming tanks. Wooden plugs were put in drain holes and other small holes to keep water out of D-25 and D-27 from the trimming tanks. Water also coming into D-27 from around steering gear shaft which was torn loose from the deck. As result of all pumping the trim aft was reduced from 5 feet to approximately 1 foot.

5. The following table shows results obtained in reducing the amount of radioactivity on the forecastle due to holystoning with boiler compound, lye and sand.

BB34 Serial 221 15 August 1946

Frame No.	Readings in Roentgens 7th Aug.	8th Aug.	9th Aug.	10th Aug.
Bow	1.6	.7	.7	.6
10S	1.7	.6	.5	.45
10P	1.6	.5	.5	.5
20S	1.6	.62	.5	.5
20P	1.3	1.2	.5	.5
30S	1.5	1.3	.6	.6
30P	1.3	1.2	.5	.5
40S	2.0	1.1	.6	.5
40P	2.0	1.0	.7	.5

6. The following table shows amount of radioactivity on the main deck aft where decontamination consisted of cleaning up debris, jettisoning gear, sweeping and one (1) washing down with salt water.

Frame No.	Readings in Roentgens 7th Aug.	8th Aug.	9th Aug.	10th Aug.
70S	1.6	1.6	1.2	1.3
70P	1.2	1.2	1.3	1.5
80S	2.0	3.0	.8	.9
80P	1.6	3.0	1.3	.9
90S	2.4	.5	.9	.6
90P	1.7	1.0	.9	1.0
100S	2.6	.7	.65	.6
100P	1.7	.8	.9	1.0
110S	1.5	1.3	1.0	.9
110P	1.2	1.5	2.0	1.3
120S	2.0	.8	.95	.8
120P	1.8	1.0	.9	.6
130S	1.8	1.5	1.0	.3
130P	1.6	*13.0	.8	.7
Stern	.99	1.5	2.0	--

*Paint chippings.

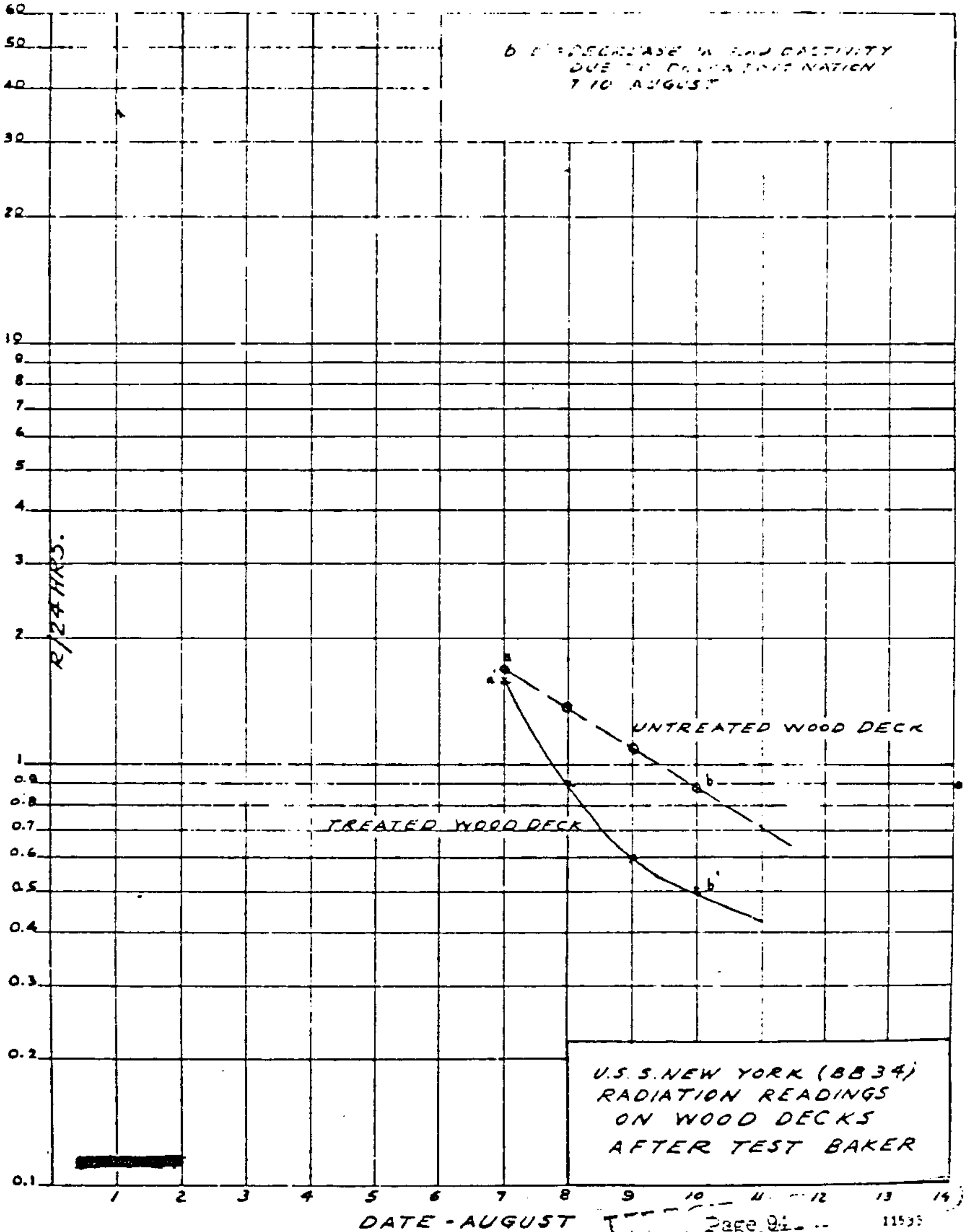
[redacted]

BB34 Serial 221 15 August 1946

As can be seen by these readings monitors were not consistent. Radioactivity on the main deck aft apparently reduced some with little or no decontamination process, although there was no radical decreases as were on the forecastle after only one application of holystoning with boiler compound, lye and sand.

R. J. CONNELL.

[redacted]


R/24 HRS.
UNTREATED WOOD DECK
TREATED WOOD DECK
U.S.S. NEW YORK (BB34)
RADIATION READINGS
ON WOOD DECKS
AFTER TEST BAKER
DATE - AUGUST

CROSSROADS U.S.S. WAINWRIGHT (DD419)

August 5, 1946

MEMO TO COMMANDER TASK GROUP ONE POINT TWO (JTF-1)

Subject: Test BAKER, Summary of reboarding operations, Aug.4-5.

Ship's personnel continued reboarding operations on WAINWRIGHT. This is an unofficial summary presented for whatever interest it may have.

August FOURTH Boarded at 0840 and evacuated at 1630.
2 groups relieved every 4 hours (topside).
1 group remained full time (engineering).
Lighted off #3 boiler and ship's service generator.

Continued scrub down with boiler compound-lye solution. Completed coverage all topside areas. Re-worked other areas previously treated as before. Scrubbed down sides with lye solution. Washed off with three hozes @ 120 lbs. 6-8 ft. distance using P-500 on LCVP. Jettisoned all canvas except cover #3 gun mount. Strung life rafts astern.

Complete closing up #2 boiler. 650# hydrostatic test pressure dropped 1 lb/min. Continued repairs pumps and electrical boxes after engineroom.

DSM ordnance and ECO electronics inspection groups aboard.

HAVEN monitors present.

August FIFTH Boarded at 0810 and evacuated at 1700.
2 groups @ 6 hours (topside).
1 group remained full time (engineers).
Lighted off #3 boiler and ship's service generator.

Continued scrub-wash down with lye solution all topside areas as before. Removed serving from lifelines-strung life floats astern.

Continued work engineering deficiencies as before.
HAVEN monitors present 0915-1530.

[redacted]

GENERAL REMARKS:

A. Status engineering deficiencies at 1700L/5th.

1. Distilling condenser pump and motor on DIXIE for repair salt water damage-evaporators out pending return estimated 10 August.

2. Thrust collar #2 generator on DIXIE for sample mfg. new.

3. #2 main condensate and booster pump, scored bearing and cracked and frozen oil deflector ring-ship's force.

4. Magnetic electric controllers for condenser pump (1) above - ship's force attempting to dry out salt water damage after engineroom.

5. Boilers:

#1 - Out of commission with unlocated leak which occurs middle of tube nest above 150 lbs. pressure. Today's test leak did not appear until about 610#. Wedge cuts are the only way believed possible to locate this leak but ship's force has been working over four weeks attempting to locate by other means.

#2 - In commission for auxiliary (500 lbs.) steaming only. Believe 600# underway steaming would cause more tube failures.

#3 - OK

A. Radiological Aspects. Since reboarding the 1st ship has had 3 different monitors assigned. Recorded data for that monitor (and assistant) aboard on 3rd and 4th is attached for information and is only record available except that returned to HAVAN. The results of scrubbing and washing down (paint removal) are shown by the checks made on the 4th - are typical of results obtained, and for convenience are listed here:

[redacted]

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GENERAL REMARKS (Continued)

	Focsle Deck (Port)	4th - Before	4th - After
	Frame 00	.3	.2
	10	.3	.2
	20	.4	.3
	30	.4	.25
	40	.4	.25
	50	.5	.35
	60	.5	.35
Break of deck	70	1.0	.5
	60	.3	.2
	70	.4	.25
	80	.5	.35
	90	.4	.35
	100	.4	.4
	110	.4	.25
	120	.4	.25
	130	.4	.3
	140	.5	.4
	150	.45	.55
	160	1.0	.25
	170	1.0	.25
	180	1.4	110
	190	2.0	1.0
	Stern	1.4	.4

The main deck and focs'le deck today the 5th with washdown not fully completed indicated about a .15 port side and .1 stbd. The general average below decks today dropped to .1 or below. Full coverage has been made each morning on dry clean decks and time has allowed only a few checks after completion of days operations but indications are fairly conclusive that the decrease can be attributed to the paint removal. Readings the next day after about 16 hours are not decreased from the last previous days and in some cases seem to have increased. Because of the many factors involved there have been exceptions to the examples above which represent the over-all picture - - some have been better - - some not so good. Decontamination by the ship has been no more or less than paint removal by the use of caustic solution, elbow

[redacted]

GENERAL REMARKS (Continued)

grease and solid steam high pressure wash. As the readings have decreased so has the "background" and such material as serving on lifelines now show up as "hot" are being removed.

Respectfully

L. W. SEDGWICK, Cdr., USNR Comdg.

cc: Dep DSM (W/O R readings)

U.S.S. WAINWRIGHT (DD419)

8 August 1946

MEMORANDUM TO COMMANDER TASK GROUP ONE POINT TWO.

Subject: Test Baker, Reboarding Operations, August 6-7-8.

Ship's personnel continued reboarding operations on WAINWRIGHT. This is an unofficial summary presented for whatever interest it may have.

August 6, 7, 8 Boarded 0800 and evacuated 1700 daily.
All hands remained full time.
Lighted off #3 boiler and ship's service generator.
Continued scrub-wash down with boiler compound-lye solution topsides and engineering upkeep.
HAVEN monitors present.

General Remarks.

(a) Status engineering deficiencies at 1700L/8th.

(1) Thrust collar #2 generator on DIXIE as sample for mfg new.

(2) Starboard engine jacking gear. Frozen gear ring. Ship's Force. Estimated completion 10th.

(3) Boilers. No. 1 and No. 3 OK. No. 2 suitable 500 lbs. auxiliary steaming.

(b) Radiological aspects. Main deck readings now average, .05-.06. At 1700L/8th est 99.9% topsides surface below .10 R/day. Monitor surveys now made with 263's and earphones. CRS boiler uptakes (port side) with all paint removed read .096 R/day. Bridge wings (port side) aluminum the same. No attempt to reduce upper surfaces of stack, masts--not deemed practicable unless made mandatory. Interior spaces below .10 - - today's surveys indicate contamination of passageways crews compartments, mess hall, etc., by

[redacted]

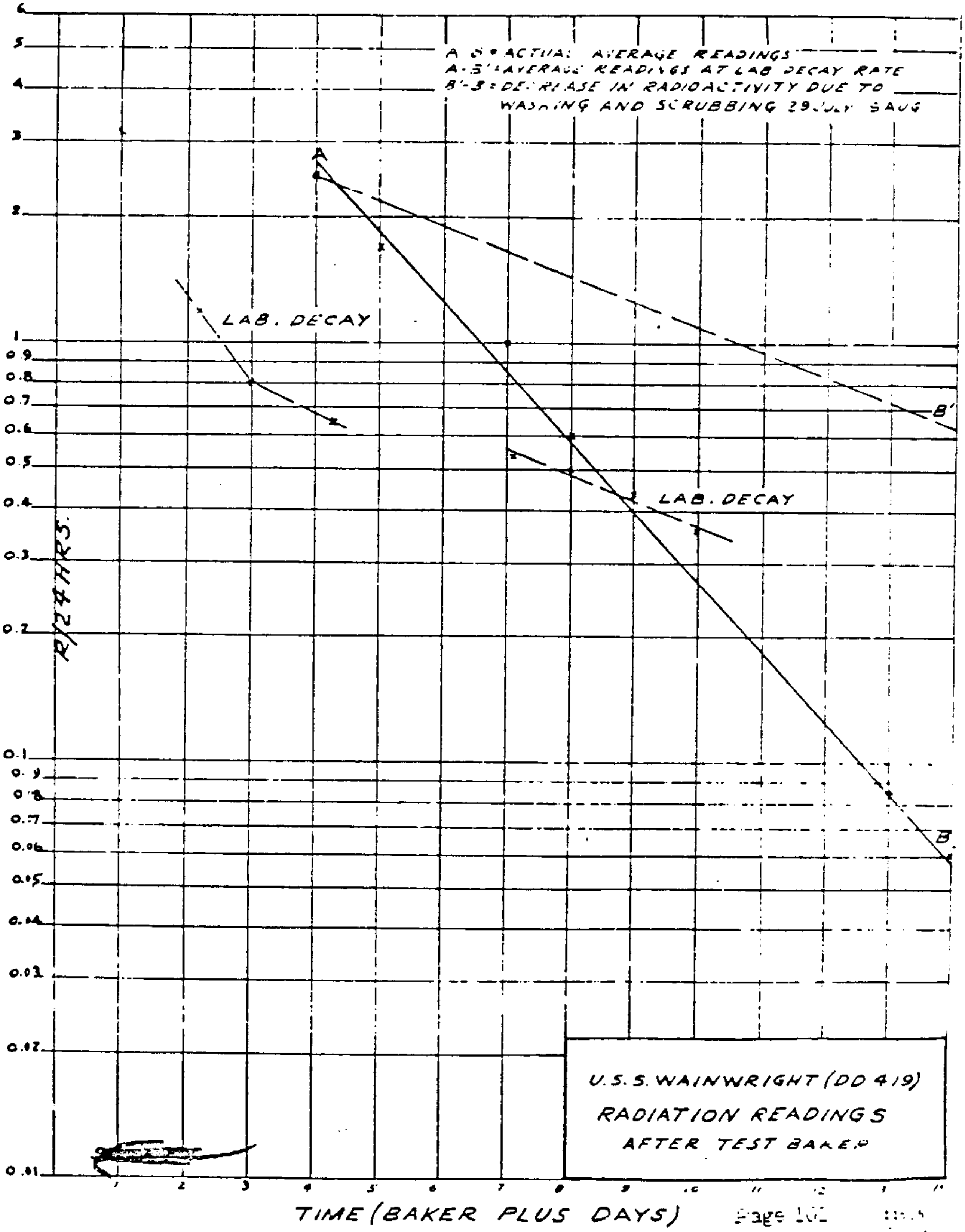
personnel from topside. Contamination is not excessive but is apparent. Some engineering valves above tolerance and have been marked for personnel to stay clear. Sonar room continues about .5 -- original readings below .10 in one icebox have increased to .3 plus -- investigation will be made tomorrow for contamination when cleaned several days ago. Hot material will "induce" (descriptive use only) steel for several feet around it. All monitors are unanimous in agreeing that underway in clear ocean water would materially help the radioactivity decrease.

In view of the present low level of radioactivity and the improvement in material condition of readiness in engineering this is the last summary report submitted and information concerning RFS, etc., will be furnished the group commander by regular channels.

Respectfully,

L. W. SEDGWICK
USS WAINWRIGHT
Commanding

UNCL...


A-B = ACTUAL AVERAGE READINGS
A-B' = AVERAGE READINGS AT LAB DECAY RATE
B'-B = DECREASE IN RADIOACTIVITY DUE TO WASHING AND SCRUBBING 29 JULY 5 AUG
A
B'
B
LAB. DECAY
LAB. DECAY
R/24 HRS.
U.S.S. WAINWRIGHT (DD 419)
RADIATION READINGS
AFTER TEST BAKER
TIME (BAKER PLUS DAYS)

U.S.S. NIAGARA (APA-87)
c/o Fleet Post Office
San Francisco, California

20 August 1946

From: The Commanding Officer.
To : The Director of Ship Material.

Subject: Decontamination - Report on.

Reference: (a) CTG 1.2 Dispatch 190946Z of August 1946.

1. This ship was reboarded on 30 July 1946 (Baker plus 5). At that time the maximum Geiger reading obtained was 0.40 R/day. The compartments that were below the waterline had a higher Geiger count than others; at the time the radiological monitor stated that no man was permitted closer than five (5) feet to the ship's hull in these compartments. The afternoon of reboarding the NIAGARA got underway to shift her berth from the target array to less "hot" waters near the entrance of the lagoon.

2. For a day and a half after reboarding all decks and bulkheads in compartments above the waterline were washed down with soap and water. The sides of the ship were also scraped to a distance of approximately five (5) feet below the waterline to remove marine growth. No Geiger counter was available at this time so the effectiveness is not known.

3. On the afternoon of 1 August the NIAGARA got underway and put to sea to wash the ship's sides. A speed of ten (10) knots was maintained that afternoon and night. This reduced the Geiger count approximately 40%. The following morning speed was increased to fifteen (15) knots; however, this did not reduce the radioactivity any more.

4. Upon reentry into Bikini, hogging lines with scrapers attached were led around the ship and the bottom scraped in an attempt to remove some of the marine growth. After two days of scraping a

[redacted]

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monitor made an inspection finding the ship below 0.10 R/day throughout. The hottest spot was a portion of the ship's hull adjacent to the gangway; a reading of 0.095 R/day was obtained here. This reading was approximately 0.05 R/day higher than the rest of the ship. The safe distance from the ship's hull had been reduced from five (5) feet to one (1) foot. Therefore it was apparent that the scraping had done some good.

5. After the inspection by the radiological monitor two more days were spent in scraping the hull. During this time the entire bottom, sides, and waterline were scraped. This scraping was followed by another inspection on 5 August. At this time the monitors declared the ship radiologically safe in all parts and gave it RADSAFE clearance required to depart from Bikini.

6. Due to the position of the NIAGARA's anchorage, materials from decontaminated ships were washed against the ship. To prevent this material from clinging to the ship's sides the waterline was washed down each day for a week with fire hoses and the bottom was periodically scraped. At the end of a week another Geiger inspection showed a maximum of 0.082 R/day at frame 68; the rest of the ship was below 0.018 R/day.

7. With the exception of the procedures already mentioned, no decontamination was done on the ship. No paint was chipped or removed.

8. At the time of the blast the point of detonation was approximately on the ship's port quarter. The effect of this was noted from the Geiger readings even after the hull had been scraped several times. For instance the results of one inspection showed the following:

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Decontamination - Report on Cont'd.

FRAME NO.	R/DAY PORT	R/DAY STBD
14	0.042	0.036
28	0.018	0.054
42	0.024	0.015
57	0.017	0.012
68	0.060	0.048
82	0.052	0.024
93	0.053	0.018
107	0.042	0.072
110	0.079	0.072
122	0.096	0.048
135	0.036	0.012

W. H. STANDLEY, Jr.

cc:
CTG 1.2.

[redacted]

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JOINT TASK FORCE ONE
DIRECTOR OF SHIP MATERIAL
U.S.S. WHARTON (AP7)

014K2/A20

14 August 1946

MEMORANDUM

Subject: Comments on Radiation Measurements on Target Submarines.

Enclosure: (A) Tabulation of daily Geiger readings.
(B) Curves of Radioactivity Decay for DENTUDA, TUNA, SEARAVEN, PARCHE and SKATE.

1. Daily topside readings of surfaced submarines were taken at about three feet above deck with a Geiger - Mueller counter at five selected spots. These readings were recorded in Roentgens per twenty-four hours and are tabulated in enclosure (A). Monitors taking readings and the instruments with which they were taken varied from day to day.

2. Trends indicated by curves plotted from the above-mentioned readings and pertinent information on the ships concerned is as follows:

DENTUDA - Had been submerged during Test Baker and was surfaced on Baker plus two. Ship is about a year and half old, paint is very thin and there is very little rust. Decontamination measures consisted primarily of topside scrubbing by ship's force using lye and boiler compound. The curve shows a rapid continuous rate of decay with a half life of about 2.5 days.

TUNA - Had been submerged during Test Baker and was surfaced on Baker plus two. Ship is old and has considerable paint and rust. Decontamination methods consisted primarily of topside scrubbing

[redacted]

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by ship's force and also a lye and boiler compound bath followed by a wash applied by an ATF on Baker plus 5 and 6. The curve shows an initial decay rate similar to that of the DENTUDA with a half life of about 2.5 days which lengthens to about 3.5 days as the radiation approaches 0.1 R/24 hours.

SEARAVEN - Had been submerged during Test Baker and was surfaced on Baker plus four. Ship is old and has considerable paint and rust. Decontamination measures consisted of daily scrubbing by ship's force after Baker plus five together with several lye and boiler compound baths applied by an ATF after Baker plus 12. The curve shows an initial decay rate similar to that of the DENTUDA with a half life of about 2.5 days with a later change at Baker plus twelve to half life of about 5 days. Note that this is similar to the half life indicated for the PARCHE and SKATE, both of which had been on the surface for Test Baker.

PARCHE - Had been surfaced during Test. Ship has an average accumulation of paint and rust. Decontamination measures consisted of limited daily scrubbing by ship's force after Baker plus six with lye and boiler compound bath and also wash treatments applied by an ATF at intervals on and after Baker plus twelve. The curve shows an initial decay rate with a half life of about 4.2 days followed by a definite reduction in measured radiation at Baker plus twelve and a resumption of a steady decay rate thereafter with a half life of 4.5 days. This is the only positive indication in any of the submarine curves of the probable effectiveness of decontamination measures in reducing the overall average radiation from this type vessel.

SKATE - Had been surfaced during Test Baker. Most of the superstructure ... decking had been blasted from the vessel in Test Able leaving the bitumastic covered hull fully exposed. The curve shows an unchanged decay rate with a half life of about 5.2 days. Decontamination methods and measures are indicated on the chart.

3. No effect has been made to co-relate indicated radiation on Baker Day with distance from the center of blast. Knowing decay rates of sodium salts or other substances with which the ships may be contaminated, the date, particularly for the TUNA and SEARAVEN, may be useful in indicating type and degree of contamination. Shifting of berths of the TUNA and DENTUDA on Baker plus three and the SKATE on Baker plus six from the target area to uncontaminated moorings does not appear to be significant.

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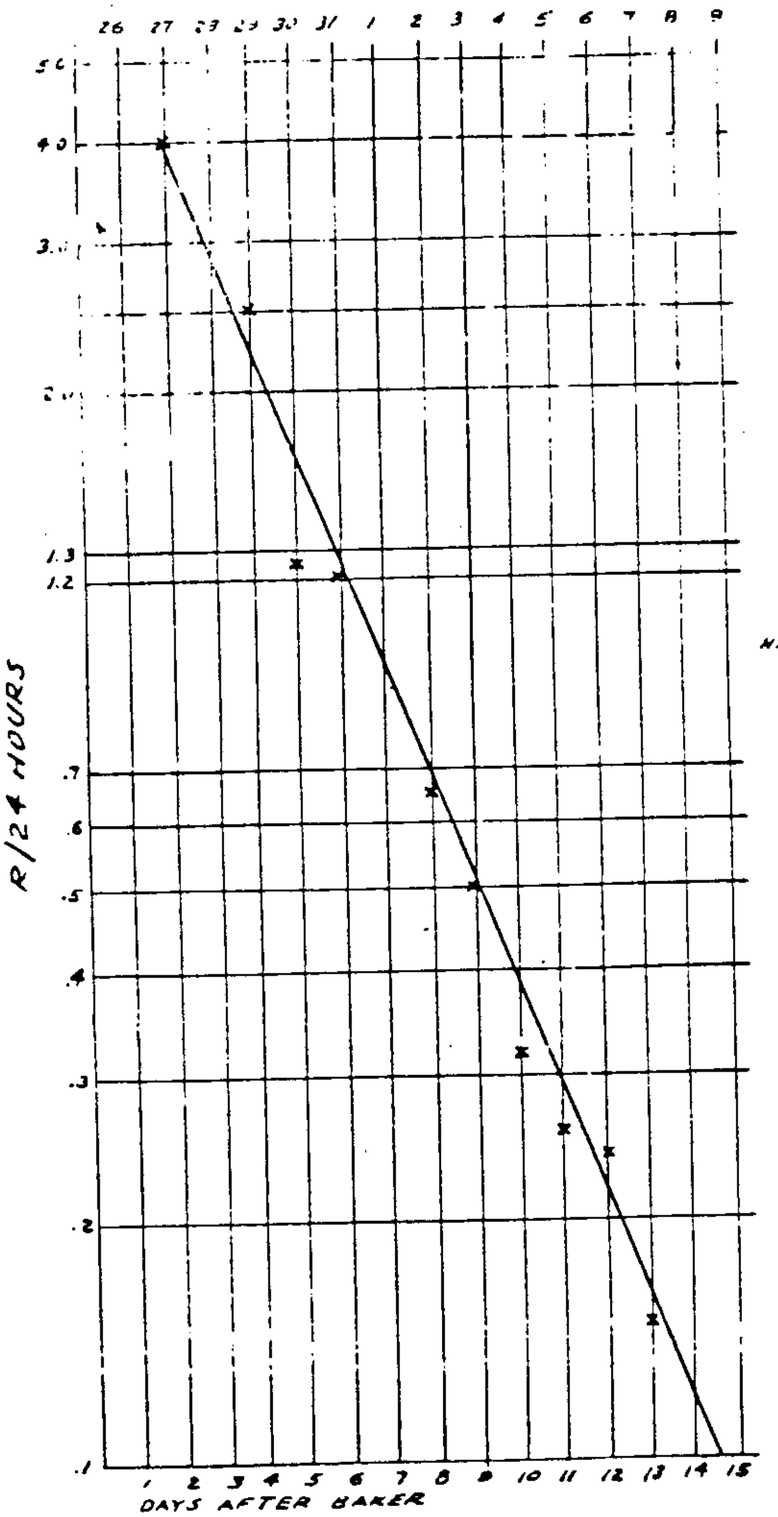

$R = 7.05e^{-.283t}$

HALF LIFE = $\frac{\log 2}{.283}$ = 2.45 DAYS

U.S.S. DENTUDA (SS 335)
CURVE OF
RADIOACTIVITY DECAY
AFTER TEST BAKER

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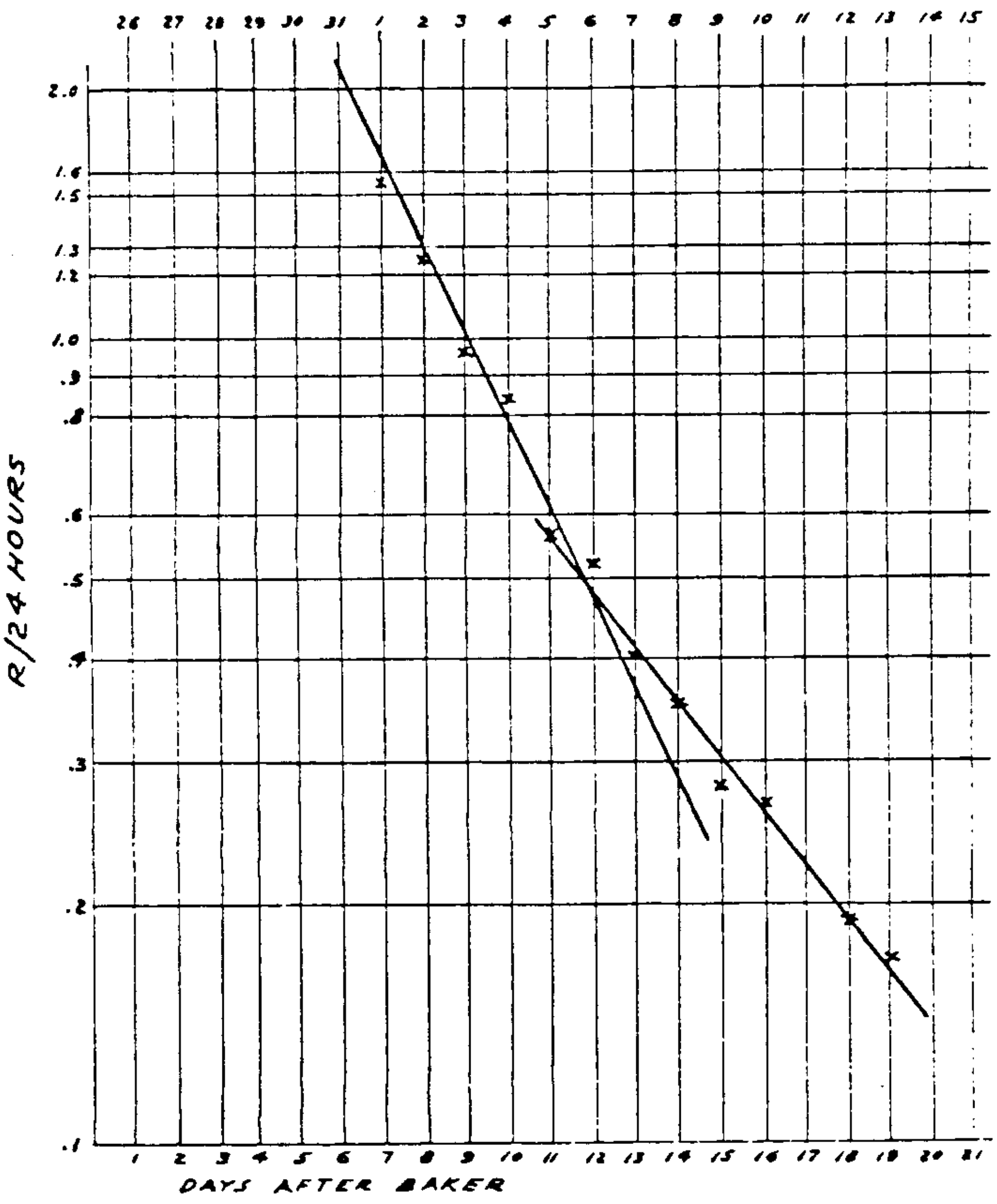

U.S.S. SEARAVEN (SS196)
CURVE OF
RADIOACTIVITY DECAY
AFTER TEST BAKER

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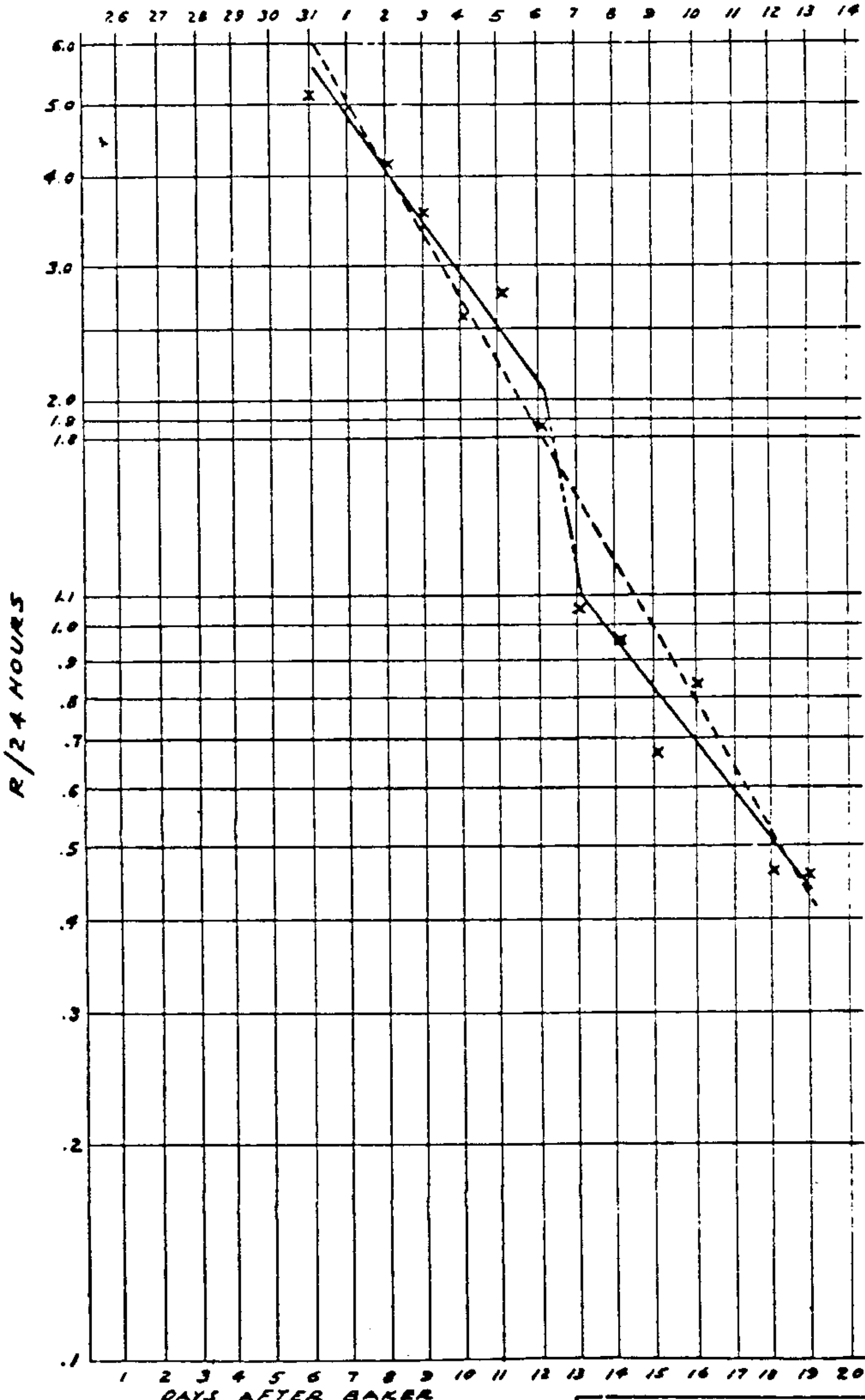
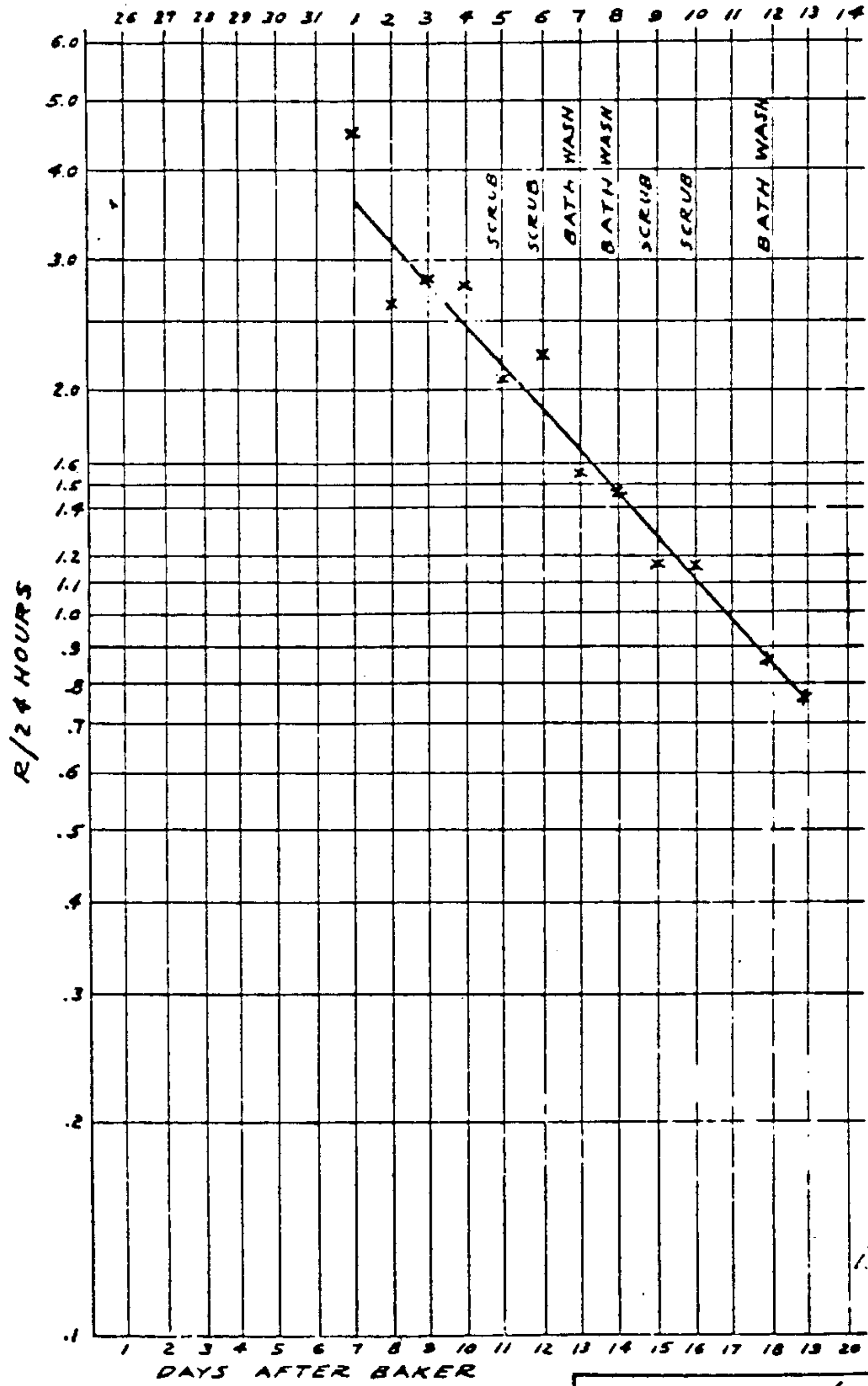


U.S.S. PARCHE (SS384)
CURVE OF
RADIOACTIVITY DECAY
AFTER TEST BAKER



U.S.S. SKATE (SS 305)
CURVE OF
RADIOACTIVITY DECAY
AFTER TEST BAKER

[redacted]

11435

SUBMARINE RADIATION

U.S.S. DENTUDA (SS335)

Date	Bow	Fwd. CT	Aft C.T.	Aft	Stern	Average	Remarks
25							
26							
27						4.0	
28							
29						2.5	
30	1.2	1.25	1.6	1.0	1.2	1.25	
31	1.2	1.1	1.5	.95	1.2	1.2	
1							
2	.7	.7	.85	.5	.6	.67	
3	.45	.6	.5	.42	.5	.5	
4						.31	
5						.26	
6	.2	.3	.3	.2	.2	.24	
7	.12	.16	.15	.15	.14	.15	
8	.05	.06	.06	.05	.05	.054	
9	.048	.06	.072	.06	.048	.057	
10	.036	.038	.05	.038	.036	.04	

[redacted]

SUBMARINE RADIATION

U.S.S. DENTUDA (SS335)

Date	Bow	Fwd. CT	Aft C.T.	Aft	Stern	Average	Remarks
11							
12	.04	.04	.096	.04	.038	.051	
13	.03	.03	.07	.02	.05		
14							
15							
16							
17							

[redacted]

SUBMARINE RADIATION

U.S.S. TUNA (SS203)

Date	Bow	Fwd CT	Aft C.T.	Aft	Stern	Average	Remarks
25							
26							
27						8.0	
28							
29						4.0	
30							
31							
1	.8	1.9	2.0	1.0	1.0	1.34	
2	.8	.85	.95	.88	.82	.86	
3	.6	.7	.85	.9	.7	.75	
4						.44	
5						.41	
6	.4	.47	.48	.52	.45	.46	
7	.28	.34	.41	.43	.33	.36	
8	.15	.18	.20	.23	.20	.19	
9	.21	.28	.3	.3	.2	.26	
10	.05	.06	.072	.072	.06	.063	

[redacted]

UNC

SUBMARINE RADIATION

U.S.S. TUNA (SS203)

Date	Bow	Fwd Ct	Aft C.T.	Aft	Stern	Average	Remarks
11							
12	.08	.12	.12	.11	.075	.101	
13	.08	.09	.10	.12	.11	.10	
14							
15							
16							
17							

[redacted]

SUBMARINE RADIATION

U.S.S. SEARAVEN (SS196)

Date	Bow	Fwd. C.T.	Aft C.T.	Aft	Stern	Average	Remarks
25							
26							
27							
28							
29							
30							
31	2.5		5.0	4.0		3.83	
1						1.54	
2	1.0	1.25	1.5	1.0	1.5	1.25	
3	.67	.85	1.15	.87	1.2	.95	
4						.82	
5						.56	
6	.4	.6	.6	.45	.5	.51	
7	.3	.46	.50	.35	.38	.40	
8	.25	.37	.35	.31	.42	.34	
9	.2	.25	.35	.37	.25	.28	
10	.26	.22	.32	.35	.22	.27	

SUBMARINE RADIATION

U.S.S. SEARAVEN (SS196)

Date	Bow	Fwd. C.T.	Aft C.T.	Aft	Stern	Average	Remarks
11							
12	.15	.2	.23	.2	.2	.196	
13	.14	.20	.20	.18	.16	.176	
14							
15							
16							
17							

[redacted]

SUBMARINE RADIATION

U.S.S. PARCHE (SS384)

Date	Bow	Fwd. C.T.	Aft C.T.	Aft	Stern	Average	Remarks
25							
26							
27							
28							
29							
30							
31	2.5	4.0	8.0	8.0	4.0	5.1	
1							
2	4.0	5.5	7.5	2.0	1.5	4.1	
3	4.2	5.3	5.6	1.6	.92	3.52	
4						2.6	
5						2.77	
6	1.5	3.0	3.5	.8	.5	1.86	
7	.56	1.45	2.5	.42	.38	1.06	
8	.54	1.50	2.10	.35	.37	.97	
9	.45	1.0	1.4	.3	.2	.67	
10	.45	1.3	1.8	.35	.18	.82	

SUBMARINE RADIATION

U.S.S. PARCHE (SS384)

Date	Bow	Fwd. C.T.	Aft C.T.	Aft	Stern	Average	Remarks
11							
12	.35	.7	.94	.2	.15	.47	
13	.32	.68	.89	.22	.18	.46	
14							
15							
16							
17							

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SUBMARINE RADIATION

U.S.S. SKATE (SS305)

Date	Bow	Fwd. C.T.	Aft.C.T.	Aft	Stern	Average	Remarks
25							
26							
27							
28							
29							
30							
31							
1	3.0	5.5	7.0	4.0	3.0	4.5	
2	2.6	2.6	3.3	2.5	1.8	2.56	
3	3.0	3.0	3.8	2.2	2.0	2.8	
4						2.7	
5						2.04	
6	2.0	2.5	2.5	3.0	.85	2.37	
7	1.5	1.65	2.4	1.7	.46	1.54	
8	1.5	1.65	2.3	1.55	.35	1.47	
9	.6	1.5	2.3	1.0	.4	1.16	
10	.4	1.3	2.0	1.5	.64	1.17	

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SUBMARINE RADIATION

U.S.S. SKATE (SS305)

Date	Bow	Fwd. C.T.	Aft.C.T.	Aft	Stern	Average	Remarks
11							
12	.35	1.25	1.5	.85	.42	.87	
13	.46	1.1	1.35	.65	.31	.77	
14							
15							
16							
17							

APPENDIX II

CJTF-1 Serial 079

of

9 September 1946

Note: This letter was superseded partially by Joint BuShips - BuMed confidential speedletter serial 1381 of 24 September 1946. (See Appendix IV). Both were superseded entirely by Joint BuShips-BuMed confidential letter All/Crossroads/C-s(99) - (o) of 22 November 1946, a copy of which is contained in Appendix IV.

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JTF-1/J-3/-
FILE: L9-7
Serial: 079

JOINT TASK FORCE ONE

9 September 1946

[redacted]

From: Commander Joint Task Force ONE.
To: Commanding Officers of Ships Listed in enclosure A.

Subject: Ships, Radiological Safety of.

Reference: (a) CJTF-1 Confidential letter, serial 075 dated 19 August 1946.
(b) CJTF-1 Confidential dispatch 282110Z of August 1946.

Enclusure: (A) List of ships present at Bikini for sufficient period following Test Baker as to be radiologically suspect.
(B) Technical instructions for radiological Monitors (Conf.)
(C) Radiological Safety instructions to be followed by all ships pending complete monitoring and clearance.
(D) Copy of CJTF-1 Confidential letter, serial 075 of 19 August 1946.

1. Reference (a), which is Enclosure (D) hereto, sets forth certain steps which would have to be taken before complete and final radiological clearance could be given any ship which was at BIKINI Atoll after Test BAKER. It was considered at that time that the steps prescribed in that letter would be sufficient, but further information and results of labratory analyses have indicated that additional safeguards are required. After discussion with CJTF-1 Radiological Safety Adviser, ComServPac in his 240111 August promulgated to type commanders and district commandants certain steps which would have to be taken, and recom-

[redacted]

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[redacted]

Subject: Ships, Radiological Safety of

mended reassembling at San Francisco the ships which had been subjected to possible contamination. This dispatch proposed a criterion of 10 days presence at Bikini after July 25 as constituting a possibility of contamination, but CJTF-1 in his 282110 stated that he considered all addressees of Reference (a) (and of this letter) as suspect, despite the fact that some of them had been present less than 10 days. Also in his 282110 CJTF-1 concurred in the assembling of the affected ships at San Francisco for resurvey and radiological clearance, with the provision of facilities also at Pearl Harbor, and the flying of monitors and equipment to Guam to provide resurvey and clearance there for ships which had proceeded to the westward from Bikini. Later, when it appeared that San Francisco might be unduly crowded by the assembling there of such a large number of ships, CJTF-1 arranged for the expansion of the monitoring organization to include the other principal west coast ports (the headquarters, however, remaining at San Francisco under COM12).

2. CNO 302200 of August directed that when ships arrived at the west coast, Pearl Harbor of Guam, carrying boats which had been exposed to radiological contamination, such boats were to be nomitored under the direction of the District Medical Officers, and boats which were found to be unsafe were to be sunk at sea in deep water.

3. The purpose of this letter is to advise individual commanding officers of the foregoing sequence of communications (most of which were addressed only to type commanders and district commandants), and also to summarize safety precautions and give information as to the monitoring and clearance organization and procedure.

4. Enclosure (C) constitutes a summary of safety precautions which should be followed until complete and final radiological clearance has been obtained. It should be emphasized that the "clearance" which all ships obtained before leaving Bikini was only a permission to sail, and did not constitute a clearance within the meaning of this letter.

[redacted]

UNCLASSIFIED

[redacted]

Subject: Ships, Radiological Safety of

5. Enclosure (B), the technical instructions for monitors, is included for information.

6. It will be noted that the list of addressees of this letter (which is also a list of ships which must be considered radiologically suspect until cleared) does not include ships which were a part of the target array, even though later re-manned and now operating. Such ships will be handled and cleared by Commander Naval Task Groups.

7. The radiological Organization is as follows:

(a). CJTF-1, Washington, D. C., through his radiological Safety Adviser, will define the policy to be followed by the monitoring organization.

(b). Captain W. E. WALSH, MC, USN., JTF-1 Medical Officer operating from the office of the District Medical Officer, Twelfth Naval District, will coordinate the monitoring work necessary for final clearance at Pearl Harbor, T.H., and on the West Coast. He will obtain and assign to the District Medical Officers of the 11th, 12th, 13th, 14th Naval Districts, and Guam necessary monitors and instruments. He will promulgate and distribute Technical Instructions to the Radiological monitors.

(c). An advisory board of senior civilian scientists is available to Captain WALSH, as are necessary laboratory facilities.

(d). The Radiological Safety Officers or monitors will be assigned to the District Medical Officers for administration and will make the actual surveys.

8. As each of the suspect ships reaches the port to which it has been ordered for radiological monitoring and clearance, it will arrange with the District Medical Officer for monitoring. The monitoring organization, under the District Medical Officer, will make a thorough survey of the ship, and provide advice and technical assistance in the elimina-

[redacted]

[redacted]

Subject: _ _ _ _ _ Ships, Radiological Safety of _ _ _ _ _ _ _ _ _ _ _ _ _

tion of such contamination as is found. When the ship is found to be safe for unrestricted use (either as a result of initial monitoring or after decontamination work) the monitoring organization will so advise the District Commandant, who will then address a dispatch to the ship giving radiological clearance, and including as info adees CNO, CJTF-1, CinCPac, BuMed, and the ship's type commander. In some few cases it may be found impossible to eliminate certain of the contamination; in such cases a conditional clearance will be given setting forth what further decontamination will be required and what precautions must be taken in the interim. Such conditional clearances however, are highly undesirable in that they limit operation and will eventually cause immobilization through lack of maintenance; accordingly they should be given only when the elimination of the contamination is manifestly impracticable, and only after Captain WALSH (Para 7 (b) above) has been consulted to insure that there are no further facilities which might avail.

9. In addition to the above dispatch report, the monitoring organization will forward by mail a complete report of the conditions found on each ship. to BuMed with copies to CNO, the ships type commander, CJTF-1, CinCPac, the ship, and Captain W. E. WALSH (MC) USN., care District Medical Officer, 12th Naval District.

10. Once this program is underway the Chief of Naval Operations will issure a weekly summary showing the current radiological status of each ship listed in Enclosure (A), this to be sent to all information addressees of this letter.

11. District Medical Officers are requested to prepare adequate copies of Enclosure (B) for use by the Radiological Safety Monitors under their cognizance.

12. It is essential that it be understood that there is a serious potential hazard involved here, which requires close attention to the safeguards laid down in Enclosure (C). It involves important factors whose

[redacted]

[redacted]

Subject: Ships, Radiological Safety of

presence in appreciable quantity has been definitely determined only after the departure of most ships from Bikini. There is no reason to believe that any personnel have been subjected to any serious hazard as yet but the safety precautions issued as Enclosure (C) herewith must be rigidly observed until a Radiological survey has been made and clearance given

F. J. LOWRY
Rear Admiral, U. S. N.

cc:
CNO
BuMed
CinCPac
ComServPac
ComAirPac
ComDesPac
ComBatCruPac
ComPhibsPac
ComSubsPac
CominPac
Com 11
Com 12
Com 13
Com 14
ComWesseaFron
ComHawseaFron
ComNavShipyard Mare Island
ComNavShipyard Bremerton
ComNavShipyard Terminal Island
ComNavShipyard Pearl Harbor
CNB Pearl Harbor.

[redacted]

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[redacted]

Subject: Ships, Radiological Safety of.

---

cc: (cont)

Com Marianas
CNB Guam
ComNavPhil
BuShips
ComGenManhattan District
CTG 1.2
Radsafe JTF-1.
CTG 1.3
ComDesRon 7
ConDesDiv 72
ComServDiv 11
DSM
Captain W. E. Walsh, MC., USN.,
c/o District Medical Officer,
12th Naval District.

Comdr. E. P. Harris, MC., USN.,
USS HAVEN (AH-112),
c/o FPO San Francisco.

[redacted]

LIST OF SHIPS PRESENT AT BIKINI FOR SUFFICIENT PERIOD FOLLOWING TEST BAKER AS TO BE RADIOLOGICALLY SUSPECT

MOUNT McKINLEY AGC-7
AVERY ISLAND (AG-76
HAVEN APH-112
WHARTON AP-7
KENNETH WHITING AV-14
FALL RIVER CA131
ARTEMIS AKA21
APPLING APA58
GYPSY ARSD-1
MENDER ARSD-2
PALMYRA ARST-3
PRESERVER ARS-8
DELIVER ARS-23
CLAMP ARS-33.
CURRENT ARS-22
CONSERVER ARS-39
RECLAIMER ARS-42
WIDGEON ASR-1
COUCAL ASR-8
ETLAH AN-79
SUNCCOK AN-80
ONEOTA (AN-85
SHACKAMAXON AN-88
ATA - 180
ATA - 185
ATA - 192
ACHOMAWI ATF-148
CHICKASAW ATF-83
ATR - 40
ATR - 87
LCT - 1184
LCT - 1420
ROLETTE AKA-99
LST - 817
LST - 881
GEO CLYMER APA27
HENRICO APA45
BOTTINEAU APA-235
BEXAR APA-237
ROCKWALL APA230
ROCKINGHAM APA-229
ROCKBRIDGE APA-228
ORCA AVP-49
BARTON DL-722
SUMNER DD-692
FLUSSER DD-368
LAFFEY DD-724
MOALE DD-693
HUNINGTON DD-781
IOWPY DD-770
INGRAHAM DD-694
DIXIE AD-14
COASTERS HARBOR AG-74
HESPERIA AKS-13
POLLUX AKS-4
ENOREE AO-69
TOMBIGBEE AOG (W)-11
AJAX AR-6
PHAON ARB-3
TELAMON ARB-8
CEBU ARG-6
ARD - 29
CREON APRL-11
SPHINX ARL - 24
FULTON AS-11
ATA - 187
ATA - 124
CHOWANOC ATF-100
MINSEE ATF-107
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NIAGARA APA-87
LCI - 1067
O'BRIEN DD725

Enclosure (A)

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TECHNICAL INSTRUCTION FOR MONITORS

[redacted]

TECHNICAL OPERATION
SHIP CLEANANCE

Mission. To detect and avoid radiological hazards connected with ships.

Situation.

1. Ships steaming or anchored in water which is contaminated with products of an atomic bomb explosion, may collect some of these radioactive products (a) in pipes and drains carrying salt water, (b) in the scale which forms on the inner walls and shells of evaporators and condensers and (c) on the external surfaces of the hull, particularly near and below the water line where marine growth and encrustation are common.

2. The longer the ship operates within such contaminated water and the greater the use of the salt water systems, the greater the likelihood of such contamination and the more extensive the contamination which may take place within the ship.

3. JTF-1 ships operating within the lagoon at Bikini subsequent to 25 July 1946 may have and those with accumulated total of ten days subsequent thereto probably have become contaminated as in paragraph 1 above.

Organization-

1. Trained radiological personnel surveyed each ship prior to its departure from Bikini.

2. The Commanding Officer of each ship was given a temporary radiological clearance report including written instructions relative to precautions to be taken when cleaning or repairs might open up radioactive deposits.

3. In ports of arrival from Bikini area, liaison between radiological monitors and District of Port Medical Officers is essential.

[redacted]

4. District Medical Officers will be provided with an approved list of trained monitors within that district.

5. It is essential to inform commands concerned with ship improvements, and operations officers, as well as cognizant yard managers and commanders.

Preparation.

1. Equipment needed: (a) A portable Geiger counter or other sensitive detector of alpha, beta and gamma rays. (b) in borderline cases samples of scale, rust, marine growth, etc. should be collected by the monitor and sent to the laboratory for analysis.

2. The particular places on deck to look for retained radioactive material are:
Depressions, low places, pumps, drains, scuppers, anywhere that water may collect and evaporate, rusty places, canvas, cordage especially unpainted or checked.

3. The radioactivity will decay with time and the intensity of radioactivity at a given place may be reduced by removal of the radioactive material. Both processes are important in safety operations.

4. The radiological status of an area of an object and the subsequent intensities thereof should be measured with a Geiger Counter or Ionization chamber.

5. For gamma rays the maximum tolerable limit of occupancy is set at 0.1 R of gamma ray per day (24 hrs.).

6. For beta rays, if the intensity in several times the gamma measurement, the tolerance limit for beta rays localized exposure to hands and feet is set at 0.5 R per day and for total body radiation with betas 0.1 R 24 hrs.

7. Among the products of nuclear fission, which may be found after an atomic bomb burst are both beta and gamma emitters. These are always accompanied by alpha emitters. These particles, once in the body,

[redacted]

act like radium, are many times more toxic, and are known to be most toxic chemical yet known. The tolerance level can not be given at this time. It is accummulative as far as a retention in body is concerned. The lethal dosage for an adult man is microscopic in amount. The measurement of alpha emitters in the field is difficult and, where there is any doubt, samples should be sent to the laboratory.

8. Materials contaminated with alpha emitters may present a serious inhalation hazard. There fore all materials showing beta and gamma activity should be considered as presenting as well an alpha particle hazard.

9. One month after the Baker bomb test the original gamma ray hazard had decayed to a level where it failed to act as a red flag dramatically warning people to keep away from contaminated surfaces. Furthermore, the absence of this warning has tended to establish in the uninformed individuals an unjustified sense of security. Although the gamma and betta intensities are reduced greatly or entirely absent, the presence of alpha emitters continues so that henceforward, alpha ray emitters will have to be dealt with as such.

10. Until a dependable field instrument is developed and made available for detection and measurement of alpha particles, their presence must be presumed to exist and the intensity of the hazard calculated indirectly for beta and gamma activity. The appropriate beta-alpha count ratio and relation to time elapsed after bomb burst provides strong presumptive evidence of their presence.

11. All surfaces once contaminated with beta emitters should be considered as presenting a continuing alpha emitter hazard until it can be proven otherwise by appropriate radiochemistry analysis. Repairs on such surfaces, including wire brushing, sand blasting and welding on such surfaces should be undertaken only when proper safety precautions can be followed.

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GENERAL CLEARANCE AND SAFETY ASPECTS

1. Hull. (a). The outer surfaces of the hull particularly close to the water line and just below may collect radioactive materials. The green seaweed that grows at the water line picks up and concentrates such materials very actively. Corals and barnacles to likewise but le ss actively so. Presumably no ship will arrive at a home port with gamma ray intensities above tolerance from hull contamination. (b) In spite of this reduction in gamma activity, alpha emitters persist in only slightly reduced amounts and the drying, scraping and sank blasting of such hull in drydock can present a serious inhalation hazard and a lesser ingestion hazard. The minute radioactive particles may be inhaled or ingested.
(c) Suitable protection can be provided against these hazards in the conduct of such work if safety precautions directed toward this end are strictly followed (See otherwise.)
(d) The scraping of such hulls be scraping tackle or by hand from stagings slung above the water line does not carry this hazard if wet technique is employed. Much of the algae growth can be scraped off with safety employing long handle scrapers over the side.

2. Small Boats. (a) These may present activity on their hulls, in salt water cooling lines and particularly in rusty spots and propellers, (b) When taken aboard ship these boats will present an additional alpha particle hazard within the ship, and should not be cleaned or scraped. Painting over the rust is only a stop gap procedure. The contamination is covered over only temporarily. It will emerge later perhaps in subtle and undesirable form.

3. Salt Water Lines. (including the fire lines and some steering tubes) (a) These will all pick up radioactivity from such contaminated water (Presumably in the iron rust for which the particles have particular affinity or in the corrosion lining them).
(b) They seldom present gamma ray hazard although at the height of radioactivity after Test Baker, a few such situations did compel evacuation of outboard tiers of bunks in some ships.
(c) Repairs involving gas cutting or arc welding could produce dangerous fumes through vaporizing particles contaminated with alpha emitters or by producing radioactive fumes or dusts.

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4. Heads and Drains. (a) These usually show activity due to continued flushing with contaminated salt water.
(b) The beta and gamma from the toilet bowls or urinals will probably not be hazardous, for the period of occupancy of these is brief.
(c) The overhead pipes and boxes may be quite active with gamma or betta rays, yet not dangerous because no one is near them for long.
(d) Repairs thereon may be hazardous from alpha emitters.

5. Rope Fenders. and cordage, swabs and gloves, may be contaminated and should be disposed of by sinking in deep water.

6. The Anchor and Chain, if they have been in contact with a highly radioactive bottom, may possess much radioactivity.

7. Loss of Radioactivity. The radioactive materials deposited on hulls and in salt water lines rarely, if ever, washes off completely, even when operating in clean sea water. After loosing some of the more loosely bound and superficial materials the decrease in the contamination will come about only by means of natrual radioactive decay, or by complete removal. Even they in some instances the plain metal may retain some alpha activity.

EVAPORATOR CLEARANCE

1. General. (a) One of the most bothersome problems has been the collecting of radioactivity in the scale in the ship's evaporators. This has resulted from the deposition of various salts and other materials due to the concentration and precipitation of whatever is in the sea water.
(b) The proper use of starch and boiler water treatment compound in evaporators, as well as other commonly used methods, effectively prevented collection of radioactive scale.

2. Distillate free from radioactivity. (a) A most fortunate feature is the failure of the radioactive materials to go over into the distillate.
(b) If fresh water lines were to be found radioactive, one would suspect a false cross connection with salt water line.

3. Radiological Hazards. (a) Gamma rays, coming out through the shell, have run occasionally to several times tolerance level, but only seldom dangerous at the place there the attendant stands (or sits) habitually. The radioactive material washes out of some ships after steam-

ing into the clean ocean water for a while and thereafter decays more and more slowly. The condenser and other salt-water piping may present a hazard similar in essential respects.
(b) Material presenting beta rays and alpha emitters is encountered in the scale when evaporator is opened.

REMOVAL OF SCALE

1. Removal of scale through the hand-hole should not be done to reduce the gamma ray hazard through the shell, for it will prove ineffective. If necessary to remove scale by an open method in order to keep the evaporatro running, then a wet process should be employed and certain precautions should be observed.
(a) Canvas or similar sheeting spread to collect scale as it is scraped out, letting none fall into bilges or elsewhere. Scale together with canvas in which it is collected to be thrown over the side into the open sea (never into a harbor with poor exchange of water with open sea). A shallow metal pan may be used for this purpose.
(b) Scale kept wet at all times.
(c) Workman wear rubber gloves.
(d) Avoid direct contact with the scale.
(e) Any loose scale scraped up and then the area mopped up, and the scale thrown over the side together with the mop, bucket, dust pan or canvas used for this.
(f) Contaminated deck areas hosed down after replacing hand hole cover.
(g) All workmen involved have thorough showers and don fresh clothing.
(h) A monitor present at the first such cleaning to instruct personnel in hazards and safe practices.

2. Manual removal of scale from the tube nest, or by "hotshocking" is a grave health hazard due to the possibility of involving very toxic materials.
(b) If the evaporator is operated correctly it should not be necessary.
(c) If, nevertheless, it is unavoidable, then special monitoring must be provided throughout the operation and certain precautions observed.

(a) Conducted on downwind side of weather decks.
(b) Restricted area screened off by wet canvas.
(c) Scale, evaporator tubes, canvas, decks, etc. kept wet at all times

[redacted]

(d) Operators wear positive pressure air masks, or Navy rescue oxygen breathing apparatus afterward. Also gloves, and clothing which should be discarded. (Ordinary filter type gas masks will not protect personnel).

(e) All loose scale must be scraped up and the area mopped up ; mop canvas and scale to be thrown over the side in deep or rapidly mixing water.

(f) Areas of the decks around evaporator, areas along path over which the tube nest was carried, and the space where the cleaning was carried out should be thoroughly hosed down.

(g) All workmen must have showers and fresh clothing.

3. Removal of Tube Nest. gets rid of some of the radiological hazard, but does not remove it all. It is hazardous and requires the presence of a monitor.

4. Acid Cleaning. The use of inhibited acid, is fairly effective and radiologically reasonable safe.

5. Boil out. With high temperature water and with boiler compound, try to remove scale. Advantage is radiological safety, since evaporator is not opened

6. Vapor Compression Evaporators. These are usually of corrosion-resistant alloy and can be cleaned by the circulation of acid solution. The evaporator is not opened and the method avoids radiological hazards. Under these circumstances, open methods of scale removal should not be used.

7. Heat Exchangers. These may be so contaminated as to require the avoidance of or actual postponement of cleaning. Most desirable is:
(a) Replacement with a new unit, throwing the old one over the side. If not available, consider,
(b) Cleaning by inhibited acid process.
(c) Cleaning mechanically under the precautions listed for hand cleaning of steam. evaporators tube nests.

[redacted]

RADIOLOGICAL SAFETY INSTRUCTIONS TO BE FOLLOWED BY ALL SHIPS PENDING COMPLETE MONITORING AND CLEARANCE.

1. The following information should be promulgated to all ships and Navy Yards.

(a) Welding or cutting operations on salt water lines, evaporators, condensers or on the hull at or below the water line in closed spaces may be done under the following conditions.

(1) The extent of metal cut in a closed space should be limited to ten (10) linear feet during any 24-hour period.

(2) The operation should be protected with a positive pressure mask or Navy rescue breathing apparatus.

(3) Unprotected personnel should be excluded from the compartment.

(4) Ventilating system should be shut down during welding or cutting operations.

(5) A suction apparatus should be used in a closed space with the intake end as close as possible to the work. The exhaust end should be so cared for that personnel will not be nearer than 15 feet upwind nor closer than 100 feet downwind.

(6) Gloves should be worn by the welder and discarded by sinking upon completion of the work. Thorough scrubbing of the hands with soap and water.

(7) Cutting or welding in the open should not be done near an air intake.

(8) Same precautions to be observed as in closed spaces except for suction apparatus.

[redacted]

(9) It is recommended that whenever possible cutting of pipe lines be done with a hack saw and blades to be discarded upon completion of the job.

(10) After a cutting or welding operation of the maximum degree (10 linear feet), the space should be monitored, washed down and painted as early as practicable.

(b) Marine growth on hulls should only be removed under the following conditions:

(1) A radiological monitor should be present.

(2) The hull should only be scraped while wet.

(3) Long handled scrapers should be used.

(4) At present all work should be performed in floating dry-docks situated where there is rapid exchange of water.

(5) All material removed should be thoroughly flushed from drydock and dock subsequently monitored.

(6) Hulls should not be sand blasted.

(7) Clothing of all employees should be monitored and discarded if above set tolerances.

(c) Small Boats:

(1) The propellers, exhaust pipes, all rusted hull surfaces below water level, and cooling systems of many small boats have become contaminated. It is recommended that all small boats which exceed the tolerance dose be placed in an isolated portion of a Navy Yard or that they be destroyed by sinking, not burning.

(2) Other measures which may protect personnel are of a temporary measure. No work on the motors, cooling system, propellers or rudder should be done. Sanding

[redacted]

wire brushing or sand blasting is specifically prohibited as the dust hazard is very serious on contaminted boats.

(d) Evaporators. The concentration of radioactive material in the scale of evaporators presents a serious problem. At the present time, it is recommended that evaporators be opened for manual scaling or repairs only in the presence of a monitor. The following precaustions should be prescribed when manual scaling is necessary to keep an evaporator operating.

(1) A shallow metal pan, canvas or similar sheeting spread to collect scale as it is scraped out, letting none fall into bilges or elsewhere--scale in its canvas all to gether disposed of over the side in deep water where rapid water exchange occurs.

(2) Scale kept wet at all times.

(3) Workmen wear rubber gloves and avoid direct contact with the scale.

(4) All loose scale mopped up and thrown over the side, together with mop, bucket or canvas used to collect scale.

(5) Deck areas hosed down after replacing hand-hole cover.

(6) All workmen involved have thorough showers and fresh clothing.

(e) For manual removal of scale from tube nest the following precautions are recommended.

(1) A monitor should be present.

(2) Scaling operation conducted on the downwind side of the weather deck.

(3) Restricted area screened off by wet canvas.

(4) Scale, tubes, canvas and decks to be kept wet at all times.

[redacted]

(5) All operators wear positive pressure masks or Navy rescue breathing apparatus, gloves, and clothing which should be discarded.

(6) All loose scale must be mopped up; mop, canvas and scale dispoled of by sinking at sea.

(7) Deck areas around evaporator, along the path over which the tube nest was carried and the cleaning space thoroughly hosed down.

(8) All workmen must have showers and fresh clothing.

(f) Deck gear. Cane and manila fenders that are contaminated should be disposed of by sinking at sea as their porosity renders decontamination very difficult. Personnel handling these articles should scrub their hands thoroughly with soap and water.

6. The advice of the monitors should be followed in arranging for the discarding of clothing, equipment and allcontaminated materials.

U.S.S. MT. McKINLEY (AGC-7), Flagship
c/o FPO, San Francisco, Calif.

P2-4
Serial: 075

19 August 1946.

[redacted]

From: Commander Joint Task Force ONE.
To: Commanding Officers of Ships Listed in Enclosure (A).

Subject: Monitoring of ships to check radiological contamination.

Enclosure: (A) Ships present Bikini area from 25 July to 10 August.

1. The ships listed in Enclosure (A) were present at Bikini following Atomic Bomb Test Baker and sustained radiological contamination in varying degrees.

2. Each ship which was sufficiently contaminated as to give rise to any possibility of personnel casualty, was given (or will be given) prior to its departure from Bikini area, instructions as to steps to be taken to prevent over-exposure of personnel. However, in most cases such instructions took the form of limitations on the lengths of time which personnel could spend in certain compartments or in the vicinity of certain pieces of equipment. It was generally impracticable to make any predictions as to the periods during which such contamination would continue. It is to be hoped that the extensive steaming in the open sea, which must follow departure from Bikini area, plus the natural decay of radioactive matter, will soon eliminate any possibility of hazard to personnel from radioactivity.

3. Before ships can be considered completely clear however, further monitoring will be necessary, particularly to insure the safety of personnel engaged in scraping ships' bottoms or doing work on evaporators (it has been found that foregoing are the two principal collecting points for

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radioactive matter).

4. Arrangements are being made for radiological monitors to be available for call to naval shipyards and principal ports on the west coast and at Pearl Harbor. Commanding Officers of ships addressed should make request for such monitors before carrying out any work involving opening up evaporators or other contaminated machinery, or before entering dry dock. The district medical officer of each naval district should be contacted to obtain such monitors. If difficulty is experienced in obtaining monitors, inform Commander Joint Task Force ONE, Chief of Naval Operations, and the Chief of the Bureau of Medicine and Surgery by dispatch. Copies of report of such monitoring should be furnished the ship, Chief of Naval Operations, Chief of the Bureau of Medicine and Surgery, and the ship's type commander.

/s/ J. A. SNACKENBERG,
Chief of Staff.

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DIRECTOR OF SHIP MATERIAL

TECHNICAL INSPECTION REPORT

Classification (~~Cancelled~~) (Changed to CONFIDENTIAL)
By Authority of JOINT CHIEFS OF STAFF JCS 1735/36 DATED 13 APRIL 1949
By Mattie B. Houchlen Date 10 AUG 1949

Radiological Decontamination of Target and Non-Target Vessels

VOLUME 2 OF 3

RECEIVED BUSHIPS SECRET FILE
DATE
ROUTE TO
SHIPS FILE NO.
ROUTE SHEET
SERIAL NO.
COPY NO. ________ OF ________
REGISTERED MAIL NO.

OPERATION CROSSROADS
JOINT TASK FORCE ONE

Classification UNCLASSIFIED
by authority of TID 9022
JGH

3

RESTRICTED DATA
ATOMIC ENERGY ACT 1946
SPECIFIC RESTRICTED DATA CLEARANCE NOT REQUIRED
USE MILITARY SECURITY SAFEGUARDS

[redacted] REG. NO. ________

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DIRECTOR OF SHIP MATERIAL

TECHNICAL REPORT

RADIOLOGICAL DECONTAMINATION OF TARGET AND NON-TARGET VESSELS

Volume 2 of 3 Volumes

By:
J.J. Fee
Commander, U.S.N.

[redacted]

RESTRICTED DATA
ATOMIC ENERGY ACT 1946
SPECIAL ... NOT REQUIRED
... SAFEGUARDS

A 72126

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APPENDIX III

NON-TARGET VESSEL

EXPERIMENTAL DECONTAMINATION WORK

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GENERAL REPORTS AND INFORMATION OF PROGRESS OF EXPERIMENTAL WORK ON REMOVAL OF RADIOACTIVITY AT SAN FRANCISCO NAVAL SHIPYARD

~~RESTRICTED DATA~~
ATOMIC [illegible] 1946 [illegible] NOT REQUIRED
SPECIFIC [illegible] SAFEGUARDS
USE MILITARY [illegible]

UNCLASSIFIED

REPORT NO. 1
EXPERIMENTAL WORK, SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO, CALIF.

Report of INSPECTION FOR RADIOACTIVITY of the USS LAFFEY (DD724) at the San Francisco Naval Shipyard, 5 September 1946

The USS LAFFEY DD724 (Crossroads Target ship) was subjected to an inspection for radioactivity on 5 September 1946 at the San Francisco Naval Shipyard. The inspection, witnessed by representatives of the 12th Naval District and the Western Sea Frontier, was conducted under the supervision of Captain W. E. Walsh (MC) USN. Other members of the inspecting party were:

Dr. Robert A. Newell - a radiologist from Stanford University
Dr. F. H. Rodenbaugh - radiologist, San Francisco
Wayne A. Chadbourn, Lieut. (MC) USN

The necessary coordination between the Shipyard personnel and the inspecting party was maintained by Lieut. Comdr. M. E. TURNBAUGH, USN, Ass't. Repair Supt. (Hull), San Francisco Naval Shipyard.

No official conclusions were arrived at upon the completion of the inspection since samples of scale and other foreign matter still had to be subjected to laboratory analysis. Unofficial opinions of the inspecting party indicated that the USS LAFFEY was not what might be termed a "hot" ship and, hence, might be considered safe working area for Shipyard personnel with a few restrictions on the work that might be carried on. These restrictions were imposed as extra safety measures pending the outcome of laboratory reports and further study of the results of the inspection by the members of the party.

The LAFFEY was in Floating Repair Dock, ARD #32 at the beginning of the inspection. Prior to the start of pumping operations, samples of the water around the LAFFEY were tested for radioactivity with negative results. At the start, it had been intended to raise the vessel in increments of about three feet, monitoring the area in each increment as it was uncovered. This plan was discarded and it was decided to pump the dock dry and monitor the hull of the LAFFEY from beneath, working upward as necessary on staging.

Pumping operation commenced at 0930 and was secured at 1040. During this period, Shipyard personnel assigned to assist the inspection party were lectured to by Lt. Comdr. Turnbaugh and Lieut. Chadbourn. The basis of these lectures were explanations of what was to be done and why. This was done to eliminate any questions in the minds of the men as to the safety precautions to be carried out in order to protect themselves from radioactive particles, and, also, to assure them that no great mysterious danger faced them. Previously, each man to participate in the inspection had been equipped with canvas suits, canvas shoes, socks, underclothing, gloves and hard hats. The final instruction was a warning to be sure and prevent any small radioactive particles from entering body thru mouth, nose or open wound.

At 1130 the monitoring party descended into the dock and started a survey of the ships bottom using Geiger counters. Particular attention was paid to areas covered with marine growth or in areas of rust. The readings obtained at this point indicated that the radioactivity of the hull was considerably below the dangerous level, hence, no further measurements on the outside hull were necessary. Sample scrapings of the bottom growth were collected in buckets and monitored. The individual members of the inspection party took samples for laboratory analysis and a large supply of the scrapings were packed in cans for shipment to Navy Dept., Washington, D. C. It is to be noted here, that despite the warning by the inspection party to the Yard workers not to handle scrapings without gloves, the members of the inspection party did not observe this precaution themselves.

After the outside hull inspection was completed, the evaporator in the Forward Engine Room was opened and the First Effect tube nest was pulled out. A large piece of canvas was spread below it on the deck, and, after flushing down in order to keep dust to a minimum, the scale on the tubes was chipped off. During the actual chipping process, all personnel, except the chippers and Dr. Newell, left the Engine Room. The chippers

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were outfitted with oxygen masks for protection of the respiratory system. Dr. Newell wore a canister mask for about twenty minutes in order to have a contaminated canister for laboratory analysis.

A section of four inch salt water piping was removed from the sea suction to the evaporator distiller pump for analysis at the University of California Radiation Laboratory. Suitable blanks were provided for the pipe system from which the section was removed, and, also, the specimen itself was properly tagged to insure its return to the vessel.

The results of those tests indicated that the salt water systems were considerably more radioactive than the outside hull plating, but still not to the degree that would be unsafe for Shipyard personnel during Yard overhaul.

Following the above tests all workmen who had participated in the inspection were lined up and Geiger Counter Monitored. The results of this monitoring indicated no appreciable radioactivity, so the men were released to turn their clothes in to store for future use if necessary.

Three items that had been used in the inspection were found to be radioactive, these were the piece of canvas, a foxtail brush and a hard bristle brush. These three items had been used for collecting samples of chipped scale from the evaporator tube nest. These three articles were encased in cement and prepared for disposal at sea, preferably in water of a depth of at least 1,000 fathoms.

As a final precaution, until the inspection board granted a definite clearance to the vessel, the hull was wet down four times a day while in dock. This was done to prevent radioactive dust particles from being blown around the Shipyard by the wind.

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SAN FRANCISCO NAVAL SHIPYARD

Code No. (200) San Francisco 24, Calif.

DD/A3-2
(28648)

6 SEPT 1946

To: ComTwelve

Subj: Telephone conversation between Captain W. E. Walsh (MC) USN, Joint Task Force One, Medical Officer, and Captain C. J. Cater, Planning Officer, San Francisco Naval Shipyard, 6 September 1946 - Confirmation of

1. Captain Walsh informed Captain Cater that it would be satisfactory for the San Francisco Naval Shipyard to proceed with all repair and alteration work on the USS WALKE, USS BARTON, USS LAFFEY and USS LOWRY, with the exception of work on the underwater body, and any other machinery in which salt water had been circulated. Work on machinery in which salt water had been circulated will be deferred pending further notification from Captain Walsh.

2. As regards the LAFFEY, which is now in floating drydock, care must be taken that no workmen enter the dock except those actually employed in the necessary tests. It was emphasized that no other workmen should enter the dock around the outside of the ship. It was satisfactory for the workmen to go inside the LAFFEY as set forth in paragraph 1 above.

C. J. CATER
Captain, USN
Planning Officer

CC: CWSF	330
District Medical Officer	163
300	100

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DISTRICT MEDICAL OFFICE
TWELFTH NAVAL DISTRICT
SAN FRANCISCO, CALIFORNIA

10 September 1946

[redacted]

MEMORANDUM

To: Commander, San Francisco Naval Shipyard

Subj: Cleaning Salt Water Systems

1. The following test procedure to be used on the cleaning of non-target ships; USS LAFFEY, USS BARTON, and any other ship participating in the Bikini operations. Accurate records are to be kept of all operations and a copy forwarded by Air Mail Special Delivery to Rear Admiral T.A. Solberg, Code 180, BuShips. A copy will also be furnished to Captain W. E. Walsh, USN, District Medical Office, 50 Fell Street, San Francisco, California.

2. (a) A solution of citrate acid and ammonium hydroxide for cleaning of salt water piping systems (strength to be determined) is to be entered into the system on the out-board leg of the suction side of the suction pump. All outlets except one of the crew's water closets are to be closed. This one outlet is to allow only a minimum flow. Then at each of the other outlets of the system, water is to be drawn off until presence of the citrate acid and ammonium hydroxide solution is definitely found to be in that section of piping. Flow through the system is to be continuous to the one open outlet. The citrate acid and ammonium hydroxide solution is to be continuously entered into the system from the outboard side of the suction pumps. (over flow from the outlet may be allowed to enter the harbor). Approximate time of operation to be one hour.

(b) Second step of the cleaning operation is to completely flush out the entire system with fresh water and concentration of standard boiler compound, one (1) pound to twenty (20) gallons of water.

(c) Continuous records of the readings of the system are to be kept.

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3. (a) Samples of copper-nickel and iron piping of salt water systems are to be tested in three different concentrations of hydrochloric acid solutions of one half normal, three-quarters normal, and one normal. The pipes samples are to be tested in small sections of about three inches in length.

(b) Similar samples are to be forwarded to Dr. Scott, University of California.

(c) The object of these tests is to determine the effect of these various solutions on the cleaning marine growth, rust and other foreign matter on the inside of the pipes. Quantitative measurements of the marine growth, rust and other foreign matter on the interior of the pipe should be made before and during the testing.

4. (a) Upon the first cleaning of heat transfer units, principally evaporators, or distilling plants. On such heat transfer equipment where scale is formed by deposits from salt water systems, the scale should be cleaned as much as possible by using thermal shock treatment.

(b) All scale that has cracked off the piping shall be thoroughly removed, using standard safety precautions.

(c) A solution of muriatic acid shall then be used to further complete the removal of scale.

(d) A monitor shall be present on opening up the heat exchange unit at all times when following the above procedure.

(e) All scale removed should be segregated and dumped at sea.

5. Cleaning of the ship's side in drydock shall be accomplished in the following manner:

(a) The ship's side shall be kept moist and marine growth shall be scraped off. The growth shall be kept wet while scraping down. All materials scraped from the side of the ship shall be cleaned from the drydock and segregated. The segregated material shall be dumped at sea.

(b) Wet sandblasting, using standard equipment, is to be then used for removing the remainder of paint on the hull. The sand is also to be dumped at sea.

T. A. SOLBERG
Rear Admiral, USN.

W. S. MAXWELL
Captain, USN
By direction

[redacted]

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

Code No. (200)

RECORD OF TELEPHONE CONVERSATION BETWEEN CAPTAIN W. G. WALSH, RADIOLOGICAL OFFICER, FOR JOINT TASK FORCE 1 AND CAPTAIN C. J. CATER, PLANNING OFFICER, SAN FRANCISCO NAVAL SHIPYARD, ON THIS DATE.

11 September 1946.

Captain Walsh stated that he had his apparatus ready to conduct the tests for sandblasting which he would like to conduct on 12 September starting at 9:00 A.M. Captain Cater stated the Yard would be ready.

Captain Walsh requested 1 small sandblaster be set up and that provisions be made for sandblasting a small area just the same as would be done under normal conditions. Captain Walsh assumed that the surface to be sandblasted would be wet down. In addition, the following equipment will be required.

3 - positive pressure masks
3 - suits of safety clothing

(the above includes the clothing for the men operating the sandblaster and one person taking samples)

Captain Walsh requested that a vacuum blasting set be set up in a similar manner for trial following the first sandblasting mentioned above.

Captain Walsh desired to conduct a test of cutting a salt water line in a closed compartment. For this test, special clothing and pressure mask will also be required. Captain Walsh desired to try a special solution which he has developed in a contaminated saltwater line. He desires that the Yard designate a line that will hold about 50 gallons, and that may be blanked off. First, this line will be flushed out with

Code No. (200)

fresh water and then the 50 gallons of solution will be put in and left for between 48 and 72 hours. Captain Walsh also desires the total capacity of all saltwater lines in a destroyer, and an APA.

C. J. CATER
Captain, USN
Planning Officer

CC: 100 165
300 335
330 240

[redacted]

COMMANDER'S OFFICE
SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO 24, CALIFORNIA

(200) 11 September 1946

NAVAL SHIPYARD NOTICE No. 244-46

Subj: Vessels Arriving from Bikini - Instructions Governing Special Tests.

1. The following instructions will govern relative to the special tests to be conducted by the San Francisco Naval Shipyard on ships employed in the Bikini operation:

A. Planning

1. Procure funds and originate Job Orders.
2. Follow up work procedures developed, smoothing same out, and put into such form as may be promulgated to other activities.
3. Compile all data necessary for the development of such reports as may be required from time to time.

B. Production

1. Develop work procedures in accordance with existing and subsequent instructions.

2. See to it that ships have radiological clearance when they enter yard.

C. Industrial Relations

1. In consultation with Production, disseminate instructions relative to safety precautions.

J. W. FOWLER
Commodore, USN
Commander

DIST: CO, OH, OF, CF
[redacted]

REPORT NO. 2
EXPERIMENTAL WORK, SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO, CALIF.

SECOND REPORT 16 September 1946 - INVESTIGATION OF RADIO-ACTIVITY of Ships from Bikini at the San Francisco Naval Shipyard starting 5 September 1946.

A First Report has been made on 6 September describing the first day of inspection for radioactivity of the USS LAFFEY DD724, drydocked in Ship Repair Dock ARD-32.

This Second Report is intended to describe chronologically subsequent events, tests, and results. At the outset it can be stated that the "Ships from Bikini" have been cleared by the monitors for all work that does not involve portions of the ship in contact with salt water. On all Bikini ships at San Francisco Naval Shipyard accordingly, all repair work has been initiated except work on the parts of the ships touched by sea water. This work, held in abeyance, will be started as soon as a monitor can be provided to work with the Shipyard in inspecting, monitoring, and issuing necessary precautions for each job. The working procedures for these jobs is dependent upon conclusions found as a result of the tests herein described.

The essential danger encountered by the presence of the radio-active ships is RADIATION POISONING of workers, which does not produce symptoms that can be detected for a long time after the initial poisoning. Radiation poisoning is effected by radioactive particles acquired in the blood, by eating, by breathing, or through an open wound.

Since even relatively minute amounts of radioactive material in the blood are likely to be harmful, it is apparent that elaborate and painstaking precautions must be taken to avoid "contamination" of workers with radioactive particles.

Accordingly the following measures were taken by this Yard:

(1) Detailed safety instructions for Yard men working on the hull or salt water connections of "Bikini Ships" have been issued.

(2) Wetting down of the hull of the LAFFEY has been continued four times daily to keep dust down to a minimum.

(3) Submarine Base, Barracks B, Bldg. 103 has been set up as a "Changing and Decontamination Center" for Yard workmen. A large room at the East end of the building has been set aside as the "Contaminated Room". Here at night Yard workmen who had been working on any Bikini Ships, completely disrobe and put all their clothing in sealed off lockers. (It would be desirable not to use this clothing again until it had been monitored for radioactivity but the fulfillment of this desire will depend on the amount of available clothing and the number of available monitors). The workers, now stripped of all clothing, walk down a strip of linoleum to the shower room where they are instructed to scrub thoroughly, especially under their finger nails. The men are told to scrub even the locker keys that they took with them from the "Contaminated Room". The workers then dry themselves off and walk on a strip of linoleum to the West end of the building where a "Clean Room" is set up. Here the worker puts on his street clothes and leaves the building, going directly from the Clean Room into the street. In the morning workers go directly into the Clean Room at the East End, remove their street clothes, leave Clean Room, and put on working clothes, either issued to them from an Issue Room in the central portion of the building or taken from lockers in the Contaminated Room. At lunch time workers are instructed to wash their hands and face thoroughly and they eat lunch at tables set up in the "Contaminated Room", all precautions being taken to avoid contact with any possible contaminated material. Workers are not permitted to reenter the Clean Room until they have had their shower at night.

[redacted]

On Friday, 6 September 1946, the day after the first in-
spection of the LAFFEY, it was desired to remove sand and dirt
on the bottom of the drydock. Lt. Comdr. Turnbaugh called Capt.
Walsh for advice. Capt. Walsh advised that the dock could be
washed down allowing mud to flow into the Bay. The drydock was
accordingly cleared of mud. Men doing the job were properly out-
fitted in safety clothing although the material handled was declared
free of radioactivity.

The following three working days were spent setting up safety
rules and procedures and preparing for further tests.

On Thursday, 12 September 1946, a sandblasting test and a
burning test on salt water piping were conducted to determine the
safety of these operations. The sandblasting test started at 1100.
Present were Navy Medical Officers, Capt. W. E. Walsh, and
Lieut. W. A. Chadbourn, Dr. F. H. Rodenbaugh, Army First Lieutenant
C. R. Calloway, all monitored in the First Report. Also present was
Dr. K. G. Scott, a physiologist from the Radiation Laboratory of the
University of California, and Mr. C. J. Rosati, a chemist from the
Industrial Hygiene Laboratory of the Mare Island Naval Shipyard.

For the sandblasting test a sandblaster and Lieut. Calloway
were lowered in a skipbox alongside the ship. The test region was
shielded from the rest of the dock by two large pieces of canvas,
one hung on each side of the test region and suspended from lines
between the LAFFEY and the ARD. The area to be sandblasted was
first wetted down and then given the usual blasting with a combination
of sand and water. Lieut. Calloway had with him a fairly large instru-
ment or machine cleaner with a filter for collecting dust particles.
It bore the name "FILTER QUEEN" and was put out by the Heathmer
Co. of Chicago. Several pieces of filter paper served as a filter.

During the sandblasting operation, Mr. Rosati from Mare Island
set up on the main deck of the drydock, near the test region an
"Electrostatic Dust Precipitator" manufactured by the Mine Safety
Appliance Co. of Pittsburgh. Air was sucked in through a small metal
tube in the center of which was an insulated wire. A high voltage put

between the wire and the tube caused dust particles in the incoming air to be deposited on the tube. The metal tube was lined with a filter paper in this test so that the collected dust particles could be investigated. The filter was changed several times during the test.

At 1130 portions of the salt water piping were measured with the radiation counter and a sample piece was selected. This was unbolted from the ship, the open ends on the ship being blanked off. The sample piece was taken to the ship's shipfitter shop. A burner and Dr. Chadbourn, each wearing an oxygen mask, closed themselves in this compartment, and the sample piece of pipe was burned through, filling the compartment with smoke. The "Filter Queen" was used to collect dust samples. The operation started at 1340 and lasted 17 minutes. Adequate provision was made to rid the compartment of remaining smoke.

All filters "contaminated" during the day's tests were taken by Dr. Scott to the laboratory for analysis.

On Friday, 13 September 1946, additional supplementary tests were initiated by the Yard, although none of the medical scientists were present.

First the sandblasting test was repeated using dust collecting apparatus with a much larger airflow capacity than before. Two standard ventilation blowers with rated capacity of 1000 cubic feet per minute were set up by Shop 17, the discharge end of each being heavily packed with a glass filter 2 inches thick. One blower was placed on the skipbox with the sandblaster. With a 6 inch intake pipe this blower circulated through the filter a measured 650 cubic feet of air per minute. The other blower was put on the main deck of the drydock in the path of the main dust stream. With a 5 inch intake this blower sucked in a measured 550 cubic feet of air per minute. This test was started at 1548 and run for 40 minutes.

On Saturday, 14 September 1946, these supplementary tests were resumed, Dr. Scott and Lieut. Chadbourn being present at 0900. Dr. Scott had previously sent the Yard some acetic acid and ammonium hydroxide. The Yard provided a 50 gallon mixing container and a reciprocating air pump for mixing operations.

A "decontaminating solution" was mixed at the Yard as follows: 25 gals. of water were placed in the mixing pot and 48 lb. of acetic acid powder was added. Ammonium hydroxide was then added until the acidity of the solution was reduced to the value pH 6.0. 34 lbs. of ammonium hydroxide was found necessary to attain this result. The solution was constantly agitated throughout the mixing operation.

The Yard opened up and blanked off a portion of the firemain having approximately 50 gal. capacity. Hose outlets were provided at each end, and the "decontaminating solution" was pumped through the blanked off section of firemain until it was entirely filled. Only about 30 gallons of solution was found required for this, indicating probably 20 gallons of sea growth in the pipe. This operation was completed at 1100 and the test scheduled to run 72 hours.

The original section of salt water piping (described in the First Report) sent to the Radiation Laboratory of the University of California was galvanized steel pipe and the solution devised was intended for steel, since it would chemically attack iron and loosen rust particles as well as dissolve marine growth. The sample of firemain selected was not steel however, it was a Copper-Nickel alloy (as is now standard for firemains) so the present test would be effective against marine growth only. Further tests on Copper-Nickel pipe are anticipated using a little sulphuric acid in the solution. Geiger Counter Readings taken at various places along the firemain were marked so that later readings will quickly determine the effect of the solution.

The burning test of Thursday was repeated by Dr. Chadbourn with a galvanized salt water pipe taken from a ship not at Bikini, the results to be used as a CONTROL.

In summary then,

The results of the tests started Thursday, 12 September 1946, have not yet been reported. It is from these results that decisions will be made on what work will be permitted on the external hulls of radioactive ships and instructions issued on how to handle the various salt water systems of these ships.

THIRD REPORT
16 September 1946
INVESTIGATION OF RADIOACTIVITY
Of Vessels from Bikini
At the San Francisco Naval Shipyard
Begun 5 September 1946

The principal activity today was the selection and preparation of various sections of piping aboard the USS LAFFEY and the USS HENRICO for a decontaminating experiment to be conducted tomorrow, 17 September, at 0900.

Aboard the LAFFEY in the morning Lt. Chadbourn monitored a section of the Firemain (copper nickel piping) in compartments A-208-L (Food Service) A-205-L (Crews Mess), A-204-5L and A-204-2L (Passageway). The workers from shop 56 who were to open up and blank off the Firemain had their tools monitored before going to work. Men working on a section of pipe forward of that which was to be blanked off did not wear gloves due to difficulty of access. This was done only after the Geiger reading showed the section to be very low in radioactivity. The men were instructed to wash their hands carefully afterwards. Tomorrow the section of copper nickel pipe will be pumped full of a decontaminating solution (1% hydrochloric acid). The section will stand for 72 hours after which the liquid will be drained off and tested.

On the HENRICO Lt. Chadbourn tested with the Geiger counter two sections of the Salt Water Flushing system (galvanized steel) located in the troop's head and found it sufficiently "hot" to warrant the experiment later with the two solutions (hydrochloric acid in one section, and a mixture of Citric Acid and Ammonium Hydroxide in the other.

Due to the nature of the experiments, Lt. Howell of the Industrial Laboratory has been called on to furnish assistance and required solutions.

No sandblasting has as yet been attempted. Efforts by Captain Walsh (MC) to secure a vacu-blaster has resulted in the information that the only ones available in the area are held by the 19th Fleet.

[redacted]

4th Report
18 September 1946
INVESTIGATION OF RADIOACTIVITY
Of Vessels from Bikini
At the San Francisco Naval Shipyard
Begun on 5 September 1946

Yesterday morning aboard the LAFFEY one experiment in decontaminating salt water piping was concluded and another begun. The experiment just concluded awaits laboratory testing before any results are known.

The section of Firemain which had been pumped full of pH 6.0 solution (Acetic Acid and Ammonium Hydroxide) on Saturday, 14 September at 1100, was blown out at 1100 yesterday. An air hose was attached to one end of the Firemain and a hose led from the other end to a steel barrel up on the main deck, and the Firemain was blown clear. The contents of the barrel were monitored and showed radioactive emission as heavy as had previously been found in the Firemain on Saturday (.010) which would appear to indicate that the decontaminating solution had brought a considerable portion of the radioactive particles out with it. The barrel of radioactive solution was hoisted overboard, using a quaywall crane, onto a truck and when taken to the Industrial Laboratory to be held there until arrangements are made for disposal. One quart of the solution was taken by Dr. Scott for a laboratory assay. After the Firemain had been blown clear of the solution,the air service was disconnected and a fresh water hose connected to the Firemain. The hose at the outlet end was led to a second barrel for examination of the first amount of flushing water. This water was found to be practically free of emission, so on the advice of Dr. Scott the discharge hose was led into the bay and flushing operations were scheduled to continue overnight. The flushing operation was begun at 1330. The leading man of X-56 who was holding the hose in the barrel when the radioactive solution was being blown from the firemain received spray and some of the liquid on his bare hands. He was advised to wash it off immediately.

The second shipboard experiment in decontamination of copper nickel salt water piping was begun yesterday after the necessary preparations by shop 56 had been completed. A section of approximately 50 feet had been blanked off and furnished with hose connections on each end. A reservoir in the form of a 50 gallon drum (steel barrel) was set up and filled with a 1.08% normal solution of Hydrochloric Acid. The acid was pulled from the reservoir thru a reciprocating air pump to the blanked off section of Firemain (which had been flushed with fresh water for 30 minutes previously). The acid circulating operation was started at 1030. The outlet from the lower end of the Firemain was led into the reservoir drum. About 35 gallons was required to fill the main. Within a matter of minutes the drum solution began to show radioactive emission. At the end of the first hour a sample from the barrel was taken by Mr. Gordon, the yard chemist, and checked for acid content. Every two hours thereafter the solution was so checked. At 1830 the acid content had levelled off to about .45% normal and it was decided to stop this stage. At 1915 the acid circulation was stopped. Air was used to clear the Firemain of acid, all acid being led into the acid barrel. This showed considerable radioactivity. At 2050 flushing operations with fresh water were started. The first barrel of water received in flushing was too active and had to be saved for disposal at sea. The second barrel of flushing water was declared by the monitor, Dr. Chadbourn, to be safe for dumping into the bay. The discharge hose was then led overboard to the Bay. The flushing was begun at 2050, and completed at 2200, at which time air was blown thru the main. At 2210 the second acid circulating phase began. The acid was of a 0.88 concentration.

The day aboard the HENRICO was spent in blanking off the flushing system piping (galvanized steel), setting up pumps, mixing tank etc., for the third and fourth piping experiments (using pH 6.0 solution and Hydrochloric Acid solution in sections of steel piping).

In the afternoon an inspection party including Admiral Solberg, Captain Maxwell and Captain Lemler boarded the LAFFEY and was shown the work in progress. Information was given and received, and will be the subject of a separate report.

EGS

. IFTH REPORT.

5th Report, INVESTIGATION OF RADIOACTIVITY of Vessels from Bikini at the San Francisco Naval Shipyard begun on 5 September 1946.

Progress and further developments in the experiments described in previous reports:

Flushing (with fresh water) of the Firemain section on the LAFFEY which had been treated with pH 6. solution continued through the night of 17 September and was secured early in the morning of the 18th. The blanked off ends were opened up and drippings were collected and put in an acid barrel. Photographs were taken of the end sections of the piping, showing the work of the solution in removing marine growth. The results can be summed up by saying that the pH 6. solution was not particularly effective in removing marine growth, although it is estimated that 90% of the radioactivity was removed.

The second phase of acid circulation in the Firemain forward on the LAFFEY was stopped at 0205 Wednesday, 18 September. Flushing s begun at 0215 and at 0300 the line, containing fresh water, was secured. aples of acid concentration were taken at intervals and a small reduction of .30 occurred. (1.08 to .79) It is estimated that the acid treatment removed 100% of marine growth and scale, and reduced radioactivity about 98%. Precise figures on the decrease in radioactivity of the acid solution between the first phase and the second phase as well as the monitoring of the piping after the decontaminating solution had been removed are contained in a report by the monitor, Dr. Chadbourn, to Capt. Walsh (MC) who is in charge of the experiments.

Yesterday afternoon short pieces of Firemain removed forward and aft of the section treated with Hydrochloric Acid and were taken up on the main deck for a future decontaminating experiment. The section taken out forward was low in radioactivity, while the section taken aft of the treated line was very high in radioactivity. Seven valves which had been found to be "hot" by the monitor were taken from various parts of the ship and made ready for immersion in a barrel of decontaminating solutión (Hydrochloric Acid). The valves range from 1 inch to 4 inches IPS, and were taken from systems such as Ice Machinery Overboard Discharge. Fire and Bilge Pump discharge, Firemain, and Firemain cutouts.

The experiment in decontaminating galvanized steel pipe aboard the HENRICO was begun, with the mixing of the pH solution (5.95 actual) and the pumping and circulating of it in part of the Flushing system of the troop's head. Circulation was begun at 1045 and after 45 minutes of circulation, pumping was secured and the solution allowed to stand. It will be blown out 72 hours from the time of securing (1130). The circulation of Hydrochloric Acid (1 normal) was begun at 1455 through a portion of the Flushing system in the troop's head. The curve of the rate of reaction was watched from hour to hour. Circulation was stopped at some time past midnight and will be detailed in the next report.

The HENRICO asked this Yard to remove a clogged section of pipe in a troop head (2-132) and it was found that this section was extremely radioactive. The section has been removed, and a new section is being put in.

An evaporator and a condenser on the hospital ship, USS BENEVOLENCE, were monitored yesterday by Lt. Comdr. Skow (MC) with expected results. The reading through the evaporator shell was not particularly high, but scale in the evaporator (which had been cold shocked previously) was found to have a radioactive emission double the normal tolerance of human beings for gamma and beta rays. It is considered that in view of this emission rate, 8 hours of work around this type of material should be the maximum. Up to 1600 yesterday no provision had been made by the ship for taking the evaporator scale away from the evaporator room. Attention to this was called by Lt. Comdr. Skow, and provision has been made to have the scale and zincs from the condensers placed on the fantail for eventual disposition at sea. The gratings in the condenser room were found to be extremely hot radioactively in one section, and orders were given to wash the gratings and bilges with Citric Acid.

Rear Admiral Solberg, Captain Walsh, Captain Maxwell, and Captain Lemler boarded the LAFFEY and BENEVOLENCE in the afternoon and examined the results of the experiments on piping. A meeting was held aboard the BENEVOLENCE regarding various decontamination procedures which will be reported upon by Lt. Comdr. Turnbaugh, Assistant Repair Superintendent, who is representing the Yard in such matters.

Clothing issued workmen for their protection is of a heavy, winter nature and has been extremely uncomfortable for the past four days when the hottest weather of the year has prevailed. The Shop Superintendent has ordered more suitable clothing.

UNCLASSIFIED

San Francisco Naval Shipyard
San Francisco 24, Calif.

16 September 1946

File (335)

MEMORANDUM

Subject: Radioactive Ships at San Francisco Naval Shipyard - Status to date

1. To date the following ships which took part in the Bikini operation have arrived at the San Francisco Naval Shipyard:

USS WALKE (DD723)
USS LAFFEY (DD724)
USS BARTON (DD722)
USS LOWRY (DD770)
USS O'BRIEN (DD726)
USS HENRICO (APA45)
USS BENEVOLENCE (AH15)

2. Partial clearance has been received from Captain W. E. Walsh (MC) USN, Radiological Officer for Joint Task Force One, for the above seven ships. By partial clearance is meant the following:

a. All work which does not involve a surface that has been in contact with sea water may proceed normally with complete safety to all workmen and without special precautions for the men in dressing or cleaning up.

b. Jobs which involve surfaces which are suspect by virtue of their being normally in contact with sea water can be worked only:

(1) When a monitor is present to inspect, monitor, and issue safety instructions for the handling of each specific job.

(2) When all workmen assigned to each job are properly dressed and instructed and have special facilities available for decontamination.

[redacted]

UNCLASSIFIED

To date only one job has been so opened because there has been no monitor to work with the Shipyard.

3. Captain Walsh is aware of the urgency for having a full-time monitor in tha Yard. He has indicated that he will have one or two monitors available for production work beginning Tuesday, 17 September.

4. Captain Walsh with the assistance of scientists from the University of California and from Stanford has directed the following investigations and tests: (NOTE: When inspection by Geiger Counter showed Beta or Gamma emissions, samples were taken for laboratory analysis of Alpha omission.)

a. Inspection for the amount of radioactivity on the USS LAFFEY in drydocks.

(1) Inspection of barnacles, sea growth, rust, and paint on the underwater body.

(2) Inspection of the evaporators.

(3) Inspection of salt water piping.

b. Experimental sandblasting on the USS LAFFEY to determine

(1) Amount of radioactivity in the sandblasted material in the bottom of the dock.

(2) Amount of radioactive material in the air immediately surrounding the sandblaster.

(3) Amount of radioactive matter in the dust stream floating to working areas on deck of the ship and on the side of the dock.

c. Experimental burning of a section of radioactive salt water galvanized steel pipe to determine the amount of radioactive matter in the resulting fumes.

[redacted]

d. Experimental sandblasting again on the USS LAFFEY, but on a much larger scale than the first experiment.

e. Experimental "deactivation" of a section of copper nickel firemain piping on the USS LAFFEY by means of a solution of acetic acid and ammonium hydroxide - USS HENRICO.

No results of benefit to the Shipyard have been given as most samples are still under analysis.

5. The Shipyard, in Barracks "B", has facilities as a "Dressing and Decontamination Center" for 58 workmen. A working procedure has been set up for preparing a man for the job and for safeguards at the end of the shift. These facilities are being expended and include laundry service in the Yard for the government issued safety clothing which the men are required to wear.

6. Full scale work on radioactive surfaces can proceed as soon as monitors are available to the Shipyard, although the working procedure for certain jobs will depend on the results of the above experiments.

PHILIP LEMLER
Production Officer

[redacted]

UNCLASSIFIED

San Francisco Naval Shipyard
San Francisco 24, Calif.

File (335)

19 September 1946

MEMORANDUM TO: Commander, San Francisco Naval Shipyard, San Francisco.

Subject: Summary of Rear Admiral Solberg's visit to San Francisco Naval Shipyard on Tuesday, 17 September 1946, regarding experimental work on the Bikini Radioactive Ships.

1. Before arriving at San Francisco Naval Shipyard on Tuesday, 17 September 1946, Rear Admiral Solberg conferred with Captain Walsh, Radiological Officer for Joint Task Force One, and with Dr. Scott from the University of California. At this conference he was made acquainted with the laboratory results of most of the experiments so far conducted at San Francisco Naval Shipyard. After this conference he visited San Francisco Naval Shipyard to see the experimental work and to discuss with the Production Officer the work in progress. He also asked for further experimental work and inspections to be set up so as to aid on conclusions being reached as to how the shipyard should proceed with each of the problems on the radioactive ships.

2. The various items covered by Rear Admiral Solberg's visit are summarized as follows:

(a) That the subject matter of how to rid a ship free of radioactivity should be classified as "Top Secret".

(b) That the Bureau of Ships in setting up a "Decontamination Section" and that they are interested in and will want information concerning the experimental work being conducted here.

(c) That he will inform the Shipyard on the following day whether or not to go ahead with the sandblasting on the USS LAFFEY. Indications at present are that it is safe.

[redacted]

(d) That the Shipyard should proceed to set up for decontaminating the evaporators on the USS BENEVOLENCE. The final order to go ahead would be given after his inspection of these evaporators the following day.

(e) That the Shipyard have the following items ready for his inspection at 1300 on the following day:

(1) Circulation of decontaminating fluids in the two sections of firemain on the USS LAFFEY be concluded and these flushed sections opened up for his inspection. Also adjoining sections of firemain which had not been decontaminated should be opened as a comparison to see the effectiveness of the decontamination process in removing scale and marine growth.

(2) One evaporator on the USS BENEVOLENCE should be opened to check for radioactivity and to have scale samples for his inspection.

(3) One auxiliary condenser should be opened and a zinc obtained for his inspection.

(f) That the Shipyard remove several salt water valves from the USS LAFFEY to test the procedure of soaking them in decontaminating chemicals in order to clear the radioactivity to the extent that the valves can be safely sent to the shop without any safety precautions in working them.

3. One item of general interest was the fact that the USS LAFFEY, which had cruised considerably in tropical waters, showed unusual heavy sea growth in her copper-nickel walt water piping. Rear Admiral Solberg stated that he was going to have this matter investigated by the Piping Section, Bureau of Ships.

/s/
PHILIP LEMLER
Production Officer

CC: 200
250 (for file)
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[redacted]

San Francisco Naval Shipyard
San Francisco 24, Calif.

File (335) [redacted]

MEMORANDUM TO: Commander, San Francisco Naval Shipyard.

Subject: Summary of Rear Admiral Solberg's visit to San Francisco Naval Shipyard on Wednesday, 18 September 1946, regarding experimental work on the Bikini Radioactive Ships.

1. The first phase of Rear Admiral Solberg's visit on Wednesday, 18 September 1946, was a conference with Admiral Edwards and Commodore Fowler regarding the overall aspect of this problem of radioactive contamination of ships.

(a) The problem of the underwater body of ships and the urgency of drydocking was to be resolved as follows:

(1) The USS LAFFEY was to be considered the example of the ship least contaminated as her hull showed little radioactivity, having been in Bikini Lagoon approximately ten days. It was noted that she had plastic paint.

(2) The ship having commercial paint which had been in Bikini Lagoon the longest was to be considered the example of the ship with the most contamination of her underwater body. Drydocking of this ship, followed by a careful examination of her hull would yield the necessary comparison with the USS LAFFEY. From this comparison it would develop whether to drydock all Bikini ships immediately or to merely note to cognizant parties that such ships were to be handled with special precautions at their next normal docking period. Rear Admiral Solberg stated that he would check Bureau of Ships records to pick this second ship to dock.

(3) It was pointed out by Rear Admiral Solberg that graving docks could be used for this work.

(b) The problem of contaminated salt water piping and engineering equipment was to be resolved as follows:

(1) A burning experiment on radioactive piping was being planned. From the laboratory analysis of fume deposits from the

[redacted]

experiment the danger involved in working radioactive matter could be evaluated. This experiment would represent the extreme condition. This experiment, together with those in process, would yield the needed information on the subject.

(2) The worst conclusion would be that complete decontamination by methods now under experiment at San Francisco Naval Shipyard, or similar, would be necessary before Yard work could proceed on radioactive ships.

(3) The optimum conclusion would be that no decontamination would be necessary before working radioactive surfaces.

(4) Meanwhile Captain Walsh was to continue to issue "Clearance for Sailing" on the lines of present policy.

This concluded the conference.

2. Rear Admiral Solberg's party and interested Yard representatives then proceeded to inspect the experimental work. Important observations follow:

(a) On the USS LAFFEY, the section of copper nickel piping decontaminated by the ammonium citrate standing solution showed that nearly all radioactivity had been removed. However, considerable sea growth remained.

(b) On the USS LAFFEY, the section of copper nickel piping decontaminated by the dilute hydrochloric acid showed 98% of radioactivity removed. Also, all sea growth and scale in the pipe has been taken out.

(c) On the USS LAFFEY, open sections of piping and valves not decontaminated were inspected and found to be of radioactive intensity below the "tolerance limit". Samples of radioactive matter were taken by Dr. Scott for further laboratory study.

(d) The USS HENRICO was not inspected because the two steel salt water piping systems were under the process of decontamination and not ready for findings.

[redacted]

(e) The USS BENEVOLENCE evaporators were inspected. Sample scale showed more than twice the "tolerance limit". It was decided on the spot to proceed with the decontamination of the evaporators by the hydrochloric acid method.

(f) The USS BENEVOLENCE No. 1 auxiliary condenser was examined. The zincs appeared to have concentrated the radioactive matter. The ship was instructed to replace all zincs immediately. The bilges of the generator and auxiliary condenser room showed undue radioactivity, necessitating scrubbing with a solution furnished by San Francisco Naval Shipyard.

A conference was held in the BENEVOLENCE to instruct the ship in the necessary procedures to follow in preparing for sailing.

3. Rear Admiral Solberg's party then proceeded to a conference with the Shipyard Commander and the Production and Planning Officers. Summarized items of this meeting follow:

(a) Regarding the USS LAFFEY:

(1) For underwater body, scrape down all barnacles and save for laboratory analysis. Follow with wet sandblast. Do not dispose of sandblasted materials until investigated by monitor.

(2) Try fresh water flushing alone as a decontaminating process on the copper nickel piping.

(3) Remove a 15 ft. section of badly contaminated and badly fouled CuNi piping for a burning test with special control over air current in compartment. This test to be directed by Dr. Walsh or Dr. Scott. Burn in circular cuts as close together as possible. <u>This test should have first priority.</u>

(4) Connect up services to USS LAFFEY.

(b) Regarding the USS BOTTINEAU:

(1) Remove 15 ft. badly contaminated and badly fouled steel piping for burning test as described for USS LAFFEY. <u>This test has first priority.</u>

[redacted]

(c) Regarding the USS HENRICO and USS BENEVOLENCE:

(1) Decontaminate the entire salt water system using a flush of fresh water only. Public Works has responsibility of taking all precautions dockside to prevent contamination of Yard fresh water lines. Lieutenant Commander Turnbaugh has same responsibility on ship's side. Monitors must be given opportunity to check lines before and after process - getting inside as well as outside readings.

(d) Regarding the USS BENEVOLENCE:

(1) The Yard is to proceed with acid decontamination of all three double effect evaporators.

(2) The Yard will furnish information and material necessary for scrubbing down the generator room bilges.

(3) The Yard is to procure six zincs and 200 lbs. evaporator scale and deliver to Captain Walsh for analysis. The ship will dispose of remainder of zincs and scale.

(e) Miscellaneous:

(1) A decontamination procedure on salt water piping using steam and cold water shock followed by flushing should be tried.

(2) Captain Walsh will furnish a summary of laboratory analysis of tests for inclusion in the Yard's record.

(3) Suitable arrangements for bachelor quarters in the Yard or on board ship was requested for two monitors.

/s/
PHILIP LEMLER
Production Officer

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SIXTH REPORT

6th Report, 20 September 1946 - INVESTIGATION OF RADIO-ACTIVITY of Vessels from Bikini at the San Francisco Naval Shipyard begun on 5 September 1946.

Work was begun yesterday to implement the decisions of the medical "strategy" board convened aboard the USS BENEVOLENCE on the 18th.

In advance of one of the measures decided upon (flushing with fresh water of the Salt Water Systems of the BENEVOLENCE and HENRICO) a careful check was being made of the Salt Water Lines to insure that proper isolation of sections being worked on at present would exist, and as a corollary, to obtain a maximum flushing effect with only portions of the Salt Water system available. All Salt Water pumps were ordered inoperable (i.e. electric pumps are to be disconnected, steam driven pumps to have valves locked).

The decision to conduct a burning test on sections of hot Firemain piping containing considerable marine growth (a top priority job) was implemented yesterday by the selection of sections of pipe from the LAFFEY and BOTTINEAU (Copper-nickel and steel respectively). Dr. Chadbourn, after monitoring the piping, selected the Shipfitters Shop aboard the LAFFEY for the test, and took samples while the burning was being done. RBA equipment was used by the burner and Dr. Chadbourn.

The senior monitor, Lt. Comdr. Skow, took readings on all three evaporators of the BENEVOLENCE in preparation for the injection of Hydrochloric Acid (1 normal) which will be started this morning. The evaporator room, because of its difficulty of access for pumps, acid barrels etc. has required considerable effort to prepare. The readings of the evaporator scale are now said to be 5 times tolerance (and hence exposure should not exceed 4-1/2 hours) not 2 times as stated in the fifth report.

BENEVOLENCE crew men who on the evening of 18 September brushed the scale from the evaporators were warned by Dr. Skow to take longer on similar jobs in the future, as due to their haste large amounts of highly active scale were deposited on piping and floor plates beneath the evaporators. Dr. Skow monitored the crew members yesterday afternoon to determine if they had acquired any radioactivity in their shoes, clothing, under fingernails etc. No activity was found.

[redacted]

The pH 6. solution in the HENRICO flushing system piping will be removed Saturday morning at 1100 (72 hours after its insertion). Acid circulation on the HENRICO was stopped at 0300 the morning of the 19th. Flushing as in previous work was performed. A second phase was not planned or carried out as in the case of the LAFFEY. The monitor was unable to get any indication of radioactivity in the acid cleaned line yesterday morning, indicating the effectiveness of this method. The previous reading had been .4. In a laboratory check on the acid, the beaker became half filled with precipitate (marine growth, corrosion etc.), and it is planned to make a weight check.

The immersion of valves in Hydrochloric aboard the LAFFEY and the decontamination of sections of Firemain out on the main deck is to be accomplished as soon as resources are available.

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20 September 1946

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From: Rear Admiral T. A. Solberg, U.S.N.
Commander Western Sea Frontier.

Subject: Report of activities in San Francisco area from Tuesday, 17 September to Friday, 20 September.

1. I arrived in San Francisco Tuesday morning, via NATS, for the purpose of conferring on conditions existing in non-target vessels and assisting in clarifying and developing procedures necessary to establish normal operation and up-keep conditions on the subject vessels. I reported to the Commandant Twelfth Naval District and, later, to the Commander Western Sea Frontier giving such information as I had been able to collect in Washington, D. C., and outlining as far as practicable certain proposals for accomplishing the objective above.

2. A careful study has been made of the records available in the San Francisco office. Also conferences have been held with officers of the Naval Ship Yard and with Doctors Rodenbaugh and Newell of San Francisco, and Doctors Hamilton and Scott of the University of California. All aspects of the situation involving the subject vessels have been discussed at length,including also the medical and legal aspects. A number of tests are underway and certain others are proposed which will give further information in determining the best procedures in all cases.

3. A number of conclusions made and proposed decisions are submitted below. On arrival in Washington, I will take the necessary steps to present the full situation to Commander Joint Task Force One and attempt to obtain decisions in substance as shown below. The vessels involved divide themselves naturally into three categories, namely: those remaining in an operative status; those being inactivated; and those slated for disposal. The latter category of vessel presents a somewhat different problem in some respects which will be discussed with you prior to my departure Friday.

a. Docking.- Tests conducted on the U.S.S. Laffey indicate that wet sand blasting procedures on these vessels can be carried out using

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present procedures without encountering any hazards. Complete sand blasting of the Laffey will be carried out shortly and the results of the preliminary test will be verified at this time. It is believed that the procedure laid down below can be carried out under absolutely safe and practicable conditions in all navy yards and in all types of dry docks.

(1) Remove all marine growth by careful scraping under wet conditions, preferably as the dry dock is being pumped down.

(2) Collect from the bottom of the dock under wet conditions all of the marine growth so removed, including any found on propellers.

(3) Dump the above material at sea.

(4) If the ship is to be painted or touched up carry out the usual wet sand blasting procedure and collect all sand used, place in barge, and dump at sea.

NOTE: It probably would be safe, from tests made to date, to dispense from collecting sand used in sand blasting and dumping at sea. However, it is felt that the safest and soundest procedure is to carry out the dumping procedure. Attention is also invited to the fact that this procedure will be carried out only on the first docking of the subject vessels subsequent to their departure from the Marshalls area.

b. Salt Water Lines.- It would be highly desirable to decontaminate completely all salt water lines when practicable; however, it is felt that, particularly in the cases of vessels which are to remain in an operative status, that there is no immediate necessity for carrying this out. Tests to date have indicated on the ships inspected that all salt water lines can be used normally and that all normal routine repairs involving extensive cutting and welding can be carried out without encountering any hazards to workmen. However, it is considered that one minor restriction must be placed on salt water piping systems in order to be on firm ground in all respects. This restriction involves only instructing each vessel that, in case any section of salt water piping is renewed, the affected section must be sunk at sea. This will obviate any possible danger which may not have been determined.

c. Evaporators.- In some vessels at least because of the mass or volume of scale which is present, there exists also the possibility of the greatest amount of active material being present. Consequently, it is

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considered necessary that acid cleaning of all evaporating units of these vessels should be carried out once and as soon as practicable and preferably while the vessel is at sea or perhaps in an open roadstead. Acid cleaning was formerly an accepted method of cleaning but, at the present time, is restricted by the Bureau of Ships. However, I am certain that the Bureau of Ships will accede to one acid cleaning in the case of all these vessels. Acid cleaning will remove all scale in a much more thorough manner than mechanical or other type of cleaning. I personally authorized cleaning of the evaporators of the Benevolence and the Henrico because of their early departure subsequent to over-haul.

d. Boats.- Consideration of recent information and tests indicates that the decisions made with regard to disposal and sinking of small boats probably was unnecessary. It is considered that any boats which have not been disposed of as a result of these decisions should be remonitored and decisions made on the basis of information now available.

4. As stated above, I will take up the matter of clearance for these vessels as soon as I arrive in Washington and can contact all of the agencies involved. This also will include obtaining concurrence of Manhattan District. It is believed that, in case of the Benevolence and the Henrico, clearance should be given to these two vessels prior to sailing whether or not definite instructions have been promulgated from Washington. The following type of clearance in these two cases is suggested:

"U.S.S. Benevolence cleared radiologically for all operations with the following exceptions and additional instructions.

ABLE. Salt water piping can be repaired using any welding and cutting operations necessary either by ship's forces or in ship yards. BAKER. Whenever a section of salt water piping, a fitting, or valve must be renewed, the unit removed shall be retained and thrown overboard at sea. CHARLIE. At first opportunity at sea flush out all salt water lines at each outlet

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separately at high water velocity for one-half hour. DOG. Evaporators can be opened and cleaned whenever necessary. EASY. Methods of procedure involving the first docking subsequent to 25 July 1946 are being furnished to your vessel and all yards under separate letter.

5. Captain Walsh, (MC) USN, and Major Brundage, MC, USA, were present at all conferences and the subject matter above has been discussed thoroughly with them. Both concur in the recommendations contained herein.

T.A. SOLBERG

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CJTF-1
COM12

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MEMORANDUM TO: Captain Walsh 20 September 1946

Subj: Decontamination tests under way at Naval Ship Yard and University of California.

1. The following tests are either under way or will be started as soon as practicable. These tests all have as their objective obtaining information on methods of decontamination of non-target vessels in order that unrestricted clearance for both operations and repairs can be authorized to the greatest extent possible.

a. Tests of short sections of piping which have marine growth present and show measureable activity are being made using the citrate solution, the one normal acid solution, and also plain fresh water. - The solutions are being circulated through the piping at a slow rate and readings taken periodically to determine the effects obtained. The tests involve both copper nickel and ordinary steel or wrought iron piping obtained principally from the U.S.S. LAFFEY and the U.S.S. Henrico.

b. Tests to determine the maximum amount of cutting and welding which can be performed on both copper nickel and steel piping. - Sections of piping are being obtained from the LAFFEY and the HENRICO and being cut into small circular sections in a small enclosed space. Samples of the air in this space are being passed through a filter for subsequent analysis of the filter contents to determine whether any harmful materials are present and in what concentration.

c. Tests of small sections of copper nickel and steel piping to determine strength of solutions necessary in order to obtain desired results. - Laboratory tests are to be made as soon as specimens can be obtained, using small samples of copper nickel and steel piping which have marine growths and measureable activity. The purpose of this is to determine the most desirable strength of solutions necessary in the case of citrate, boiler compound, and acid in order to remove marine growths expeditiously.

d. Tests for decontamination of salt water systems. - Arrangements are being made to conduct a large scale test on decontaminating the salt water piping system of the USS BARTON. The chemicals to be used are dependent on the results of Paragraph (c) above, but it is proposed in the first test to use the citrate type of solution. It is planned to reduce the number of outlets in the salt water system so that the amount of circulation will be relatively small and to inject into the suction side of the salt water pump the necessary strength of solution to establish conditions found desirable from (c) above. This will require, once the test is started, opening all outlets in the salt water system in succession for a short period of time until it is evident that the entire salt water system contains the desired strength of solution. This does not involve putting the salt water system out of commission as it will be in use on a restricted basis having only those outlets absolutely necessary open. Outlets from risers should be opened periodically for short periods in order to allow a new solution to enter these risers. It is planned to remove certain valves or short sections of piping prior to and subsequent to the test in order to determine the conditions existing under both conditions.

e. Tests of evaporators. - Use of the Bureau of Ships method of cleaning evaporators using muriatic acid is being authorized for the USS BENEVOLENCE and the USS HENRICO. The evaporator and associated units will be monitored and inspected before and after the tests to determine that the results desired have been achieved.

f. Tests of sand subsequent to sand blasting. - Samples of sand used in sandblasting the USS LAFFEY will be obtained for critical examination in order to determine whether or not contamination is present.

2. The above tests are for the purpose of determining as soon as practicable the best possible method for complete decontamination of salt water systems in ships. Other tests underway may not make it necessary to follow decontaminating procedures on all vessels, but it is visualized that this may be required on at least some of the vessels involved.

3. Captain W. S. Maxwell and Commander Shirley will remain in the San Francisco area to assist the Naval Ship Yard and also to assist Captain Walsh in any way possible in these projects. It is also probable that Commander Hoffman will be ordered from Washington both for the purpose of assisting in this work and in order to obtain experience with the methods developed.

T. A. SOLBERG
Rear Admiral, USN

CC:
Capt. Lemler, U.S. Naval Ship Yard, San Francisco.
Commander Western Sea Frontier
Commandant 12th Naval District.

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FROM CONWESSEAFRON 200054Z

TO NAVY SHIP YARD SAN FRAN

UR SPEED LETTER /200-30207/ DATED 16 SEPTEMBER X ONE ACID CLEANING OPERATION AUTHORIZED FOR BENEVOLENCE AND HENRICO X USE METHOD AND MATERIALS PRESCRIBED IN MANUAL OF ENGINEERING INSTRUCTIONS X OBTAIN SAMPLES OF SCALE BEFORE CLEANING X HAVE MONITORS OBTAIN READINGS OF EVAPORATORS AND ASSOCIATED UNITS BEFORE AND AFTER CLEANING X DUMP SCALE REMOVED BY HAND PRIOR TO CLEANING AT SEA X INFORM CAPT W E WALSH MC USN OF RESULTS

0300/20 SEPT BP

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1 100 210 300 330 301
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REPORT NO. 7 - EXPERIMENTAL WORK, SAN FRANCISCO NAVAL SHIPYARD

21 September 1946

Friday, 20 September 1946:

At a meeting of Ship Superintendents, Lt. Comdr. Turnbaugh outlined the experimental work yet to be done aboard the Bikini vessels. The work by ships -

(1) USS BENEVOLENCE

(a) Completion of Acid experiment on Evaporators.
(b) Flushing salt water system with fresh water.
(c) Washing floor plates and bilges in condenser room with ammonium citrate.

(2) USS HENRICO

(a) Flushing salt water system with fresh water.
(b) Opening up, draining pH 6 line on Saturday.
(c) Precipitating and weighing of contents found in acid used to clean flushing lines.

(3) USS LAFFEY

(a) Selection, preparation, and experimentation on 10 foot suction of Cu-Ni-firemain with steam-cold water shock treatment.
(b) Selection of four sections of firemain 5 to 8 feet in length, for testing as follows:

1. Solution of boiler compound, salt water, circulate through pipe.
2. Solution of boiler compound, salt water, let stand in pipe.
3. Solution of boiler compound, fresh water, circulate through pipe.
4. Solution of boiler compound, fresh water, let stand in pipe.

(c) Selection of firemain sufficiently long to cut into six pieces, each piece to be 4 inches long. Testing in laboratory by Dr. Scott and Mr. Gordon.

(4) USS BOTTINEAU

(a) Same as (a), (b) and (c) on USS LAFFEY.

(5) USS BARTON

(a) Fill entire salt water system with pH6 solution except for one head to be kept usable. (Note: one other DD to be treated, tentatively USS LAFFEY.)

Work accomplished Friday, 20 September:

Four monitor, assigned to the USS BENEVOLENCE and USS HENRICO to obtain a complete set of readings of the salt water lines for each vessel (in advance of flushing the lines with fresh water) completed the vessels in the morning and afternoon respectively.

Acid circulation in the first evaporator on the USS BENEVOLENCE was begun at 0600 and continued until night when leaks in brine lines necessitated all shells be drained and the lines repaired. The second and third evaporators were flushed with fresh water in the morning. Acid circulation of the second evaporator was not accomplished due to pump failure. The third evaporator had acid circulation between 1800 on Friday to 0330 on Saturday morning.

Saturday, 21 September 1946:

Flushing of salt water lines on board the USS BENEVOLENCE and USS HENRICO was begun Saturday morning and continued through Sunday. All outlets were let run for at least one hour. Drop in pressure prevented more than four outlets being flushed at any one time. Some mains had 12 hours flushing.

It was found in opening up the evaporators of the BENEVOLENCE while awaiting completion of piping repairs that the top half contained highly active scale not touched by acid circulation, and that the inside readings on all shells averaged about 0.24 Beta. It was therefore decided to rearrange the piping and hose connections so as to institute a complete wash cycle. This included all heat exchanger units as before and especially provided for the filling of all effects completely. All fresh water and vapor lines leading from each shell had to be blanked.

Work on the USS HENRICO evaporators (two 3-effect Griscolm-Russell evaporators) with acid was decided upon after consultation with the Production Officer. It was decided at the outset to make this a complete wash cycle as was found necessary on the USS BENEVOLENCE.

A pH6 standing solution in the 50 inch test section of fire main on the USS HENRICO was opened after 72 hours (1150). The rusults of this test on steel piping indicated the same success in removing radioactivity as had been witnessed on the USS LAFFEY. Readings before and after will be given in a separate monitor's report.

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SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, California

23 September 1946

From: J. B. Shirley, Comdr., USN
To : T. A. Solberg, Rear Admiral, USN

Subj: Progress of Work at San Francisco Naval Shipyard

Encl: (A) Copy of Memorandum from Captain Maxwell to Commander, U. S. Naval Shipyards at Puget Sound and Terminal Island.

1. Captain Maxwell went to Bremerton Naval Shipyard Sunday, 22 September 1946, and will return Tuesday, 24 September 1946.

2. Enclosure (A) was prepared in order to have in writing a confirmation of topics that would be discussed with the Commanders of the Shipyards.

3. A telephone conversation was held with Captain Maxwell today. As a result, the following recommendations are forwarded:

a. That another monitor be sent to the U.S. Naval Shipyard, Bremerton, Washington,

b. That a coordinating officer be sent to each Shipyard where work on non-target vessels will be performed and that the coordinator integrate the monitor's findings and Yard work,

c. That a definite policy be set up with respect to clearance of the non-target ships, and

d. That a set of instructions regarding the clearance of these ships and what the clearance entails be forwarded to the District Medical Officers.

4. Work on the USS BAYFIELD was started at Puget Sound.

5. The following destroyers, USS LOWRY, USS BARTON, USS WALKE AND USS O'BRIEN are to be drydocked Thursday, 26 September 1946, at Hunters Point.

6. Work on the USS BENEVOLENCE evaporator plant was delayed by finding leaky valves, drain lines completely corroded through, and unremoved scale in the upper parts of the shell. This work is going ahead and

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should be completed by Tuesday, 24 September 1946. New Drain lines are being manufactured and the valves repaired. The valves were dipped in a twice normal solution of muriatic solution from ten (10) to thirty (30) minutes and scrubbed, followed by a rinse. This reduced reading to 0.0. Length of time in the solution appeared to be a function of Geiger readings as well as the amount of foreign matter present.

7. Work on the USS HENRICO evaporator plant is progressing satisfactorily and should be complete about Wednesday, 25 September 1946.

8. Fresh water flushing of firemains carried out on the USS BENEVOLENCE and USS HENRICO did not result in a significant change in readings even though some sections had fresh water passing through for a period of twelve (12) hours.

9. Sanblasting of the bottom of the USS LAFFEY should be completed by Wednesday, 25 September 1946.

10. Results of tests on firemain section tests:

a. USS HENRICO, galvanized steel

(1) Ammonia Citrate solution pH6.0	Before	After
Outside of pipe readings	.002 to .014	.000 to .003
Inside of pipe readings	.012 and over .5	.005 to .08
Scale was still present after test.		

(2) Muriatic Acid Solution 1 Normal	Before	After
Outside of pipe readings	.002 to .02	.000
Inside of pipe readings	.007 & .4	.000 & .008
No scale remaining after test.		

b. USS LAFFEY, copper-nickel pipe

(1) Ammonia Citrate solution pH6.0	Before	After
Outside of pipe readings	.008 to .020	.000 to .007
Inside of pipe readings	.15 and over .5	.008 to .1

(2) Muriatic Acid solution 1 Normal	Before	After
Outside of pipe readings	.005 to 0.08	.000 to .007
Inside of pipe readings	(.08 to .2 (.3 to over .5	.000 to .002

11. Flushing of the USS BARTON firemain with an ammonia citrate solution should start Tuesday, 24 September 1946.

12. The firemain sections and valves of the USS LAFFEY have been removed and are ready to be tested, starting Tuesday, 24 September 1946 for

a. Copper-nickel and steel with a saturated boiler compound in fresh water.
b. Copper-nickel and steel with a saturated boiler compound in salt water.
c. Copper-nickel and steel with a thermal shock treatment, using steam and cold water, and
d. Copper-nickel and steel small sections in various strength muriatic acid solution.

Sections for (d) above were cut with hacksaws. The hacksaw blades had a reading of 0.0 after the work was completed, even though the sections themselves had a high Geiger reading.

13. The USS CHICKASKIA has started thermal descaling of the low pressure plant, internal readings will be taken Tuesday, 24 September 1946.

14. The Shipyard has initiated additional tests based on present findings to try to determine amount of foregin matter and material of pipes and valves removed by the acid solution.

J. B. SHIRLEY

Captain Maxwell (without enclosure)
Captain Walsh (without enclosure)
Lt. Comdr. Turnbaugh (without enclosure)

EPORT NO. 8 - EXPERIMENTAL WORK AT SAN FRANCISCO NAVAL SHIPYARD

Work on Monday, 23 September 1946:

USS BENEVOLENCE: Setting up of an acid mixing tank on the main deck and the hookup of the evaporators so that all six effects will be completely filled with circulating acid was accomplished during the day. The tank was set up on the main deck to simplify operations and keep the evaporator room from getting cluttered up with acid barrels, etc. Where the Yard felt it necessary, sections of piping removed from the evaporators were kept and new pipes substituted. "Hot" valves were dipped in a two normal solution of Hydrochloric Acid on the main deck. The valves showed some radioactivity after ten to twenty minutes of such treatment but were declared safe for work by X31 provided there was sufficient ventilation for anyone working on them.

The Salt Water systems of the BENEVOLENCE and HENRICO which had been flushed with fresh water Saturday and Sunday were given their final monitoring during the day. No change was observed from the previous readings, even though some lines had 12 hours of flushing. This flushing experiment was disappointing since previous observations had indicated that the scrubbing action from rapid flow water tended to dislodge foreign matter in which radioactive particles were concentrated.

USS LAFFEY and USS BOTTINEAU: Today the monitors selected the necessary lengths of piping for the tests described in the Seventh Report a), (b) and (c). The piping lengths for (a) and (b) were assembled on the main deck of the USS LAFFEY and readied for the tests. The samples required for (c) (to go to Dr. Scott for lab assay) were cut and given to the monitors for delivery.

USS BARTON: The line leading from the sea chest to the fire and bilge pump was disconnected and a line added to the first cutout valve on the fire and bilge pump. This line, when run up to a tank on the main deck, will be used to completely fill the salt water system of the USS BARTON with a pH 6. solution.

USS HENRICO: The laboratory assay of the precipitation of foreign matter in the acid from the USS HENRICO is under way, and will be finished tomorrow.

The extensive job of preparing the evaporators of the HENRICO for an acid flushing tomorrow was pushed all day, and will be pushed with three shifts until the job is finished. This vessel, along with the BENEVOLENCE, must be out of the YARD by 0800 Thursday morning.

25 SEPTEMBER 1946 - INVESTIGATION OF RADIOACTIVITY OF VESSELS FROM BIKINI, at the San Francisco Naval Shipyard.

Tuesday, 24 September:

Today progress was made in the decontamination of the evaporators of both the USS HENRICO and USS BENEVOLENCE. The evaporator cleaning of the BENEVOLENCE has been delayed by work on brine lines, overhaul of nine valves, and repair of a condensate cooler. Aboard the USS HENRICO acid circulation of the #2 evaporator was begun at 1500 and the #1 evaporator at 1550. A preliminary circulation of 80 gallons of acid was done the night before and scoured at 0300 when a leak in the evaporator feed line developed. Circulation continued through the night; the evaporators will be filled with soda ash and flushed today. On the BENEVOLENCE, the #1 evaporator was filled with soda ash and flushed by 1630. Readings by the monitors show that the evaporator is ready. The #2 evaporator, which had a preliminary circulation the night before, had circulation restored at about 1500, but due to pump failure after an hour of circulation and another line break at 1730, circulation through this evaporator was not up to schedule. Circulation continued all night. The #3 evaporator was drained of flushing water at approximately 1600 and circulation of acid begun.

On the USS LAFFEY, the steam-shock treatment of copper nickel and steel firemains was accomplished in the morning. The method was very effective in removing marine growth, cleaning the steel pipe completely and the copper nickel pipe almost completely, one small portion of growth still adhered. Monitor's readings (to be reported separately) indicated this system to be effective on this small length (10 ft.) section. A solution of pH 6. solution was mixed aboard the USS LAFFEY and a number of valves from the USS BOTTINEAU put in and checked at intervals through the night. The tests with boiler compound and fresh water (circulating and standing) on copper nickel and steel pipe were run. The compound was circulated for 30 minutes and no appreciable change in readings was found, which indicates the ineffectiveness of the solution. The sections which were left to stand will be opened after 24 hours for a check.

On the USS BARTON a mixing tank was set up on the Midship Deckhouse and the line which was connected to the fire and bilge pump yesterday was led up to the tank. Due to a shortage of chemists, preparation of the pH solution which is to stand in the lines was not accomplished. Due to the low readings in the salt water system of this vessel, the procedure will, if successful, demonstrate only the effectiveness of pH in removing small amounts of radioactivity in a complete salt water system. In order to get significant data it was necessary to drop 12 valves to procure inside readings.

The USS WALKE was chosen for the second experiment of this nature, in lieu of the USS LAFFEY which has a considerable portion of her mains dismantled. Actual injection of solution is awaiting decision of the most positive solution as a result of other experiments under way.

26 September 1946.

Wednesday, 25 September 1946:

Today saw the completion of the work on the evaporators of the USS BENEVOLENCE AND USS HENRICO. Evaporator #2 on the USS BENEVOLENCE which had acid circulation started at 1500 on 24 September was stopped at 0200 today, given a soda ash circulation and flushed. Evaporator #3 of the USS BENEVOLENCE, on which acid circulation was begun at 0100 this morning, was stopped at 1115, given soda ash circulation and flushed. On the HENRICO, acid circulation through the 2nd and 3rd effects was stopped at 0330 today and continued in the 1st effect until 0800 this morning. The #2 Evaporator (all three effects) had acid circulation until 0930 this morning. Evaporators #1 and #2 on the HENRICO were given soda ash treatment and flushed.

On the USS BARTON, pH solution was added to the firemains beginning at 2300.

Aboard the USS LAFFEY, 10 valves from the LAFFEY and BOTTINEAU were removed from their pH bath at 1600 and monitored. These valves showed maximum reduction in radioactivity in the first hour. A summary of monitor readings will be reported separately. The circulating tests with boiler compound and fresh and salt water through copper nickel and steel piping were completed and monitored. An additional test involving the circulation of boiler compound and fresh water for <u>four hours</u> has been decided upon and will be run tomorrow.

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

26 September 1946

Rear Admiral T. A. Solberg, USN
Code 180, Bureau of Ships
Navy Department,
Washington, D. C.

Dear Admiral Solberg:

Speedletter Serial 1381 of 24 September was received, and all concerned here were highly pleased with its contents.

My trip to Seattle was most beneficial, as I was able to clear up many points. Upon my arrival aboard the USS BAYFIELD, I encountered trouble trying to inspect the evaporators. The evaporator room was locked and orders were issued to the effect that no one was permitted to enter. It seems that Lieutenant Shallow (monitor) issued instructions that the evaporator room was contaminated. The reason for his action was that upon arrival aboard the BAYFIELD, two tube nests were removed from the shelves and the crew had mechanically cleaned them.

It appears that the BAYFIELD was only in Bikini five days subsequent to the Baker test and was not monitored prior to her departure. The Commanding Officer was not aware of the radiological situation. After explaining the situation we were able to reassemble the evaporators and the work of circulating muriatic acid was undertaken.

All necessary personnel precautions were taken while reassembling the evaporators. I also suggested to the Captain that the men who did the mechanical scaling of the BAYFIELD evaporators be given blood counts and urinalysis tests for a period of a month and report the situation to Captain Walsh.

While in the 13th Naval District conferences were held with Commodore Thompson, Admiral Christy and Admiral Ford, who appeared to be well satisfied with my bringing them up to date on the entire situation.

I returned to San Francisco Naval Shipyard late Tuesday afternoon. Commander Shirley left this morning aboard the USS CHICKASKIA to demonstrate and explain the procedure for circulating acid through their evaporator system. He expects to return late this evening, and will leave for Pearl Sunday night.

The USS HENRICO and USS BENEVOLENCE have been cleared and they are leaving San Francisco Naval Shipyard early this morning.

I am forwarding the progress of the experimental work at San Francisco Naval Shipyard. I might add that the interest and enthusiasm shown by the San Francisco Naval Shipyard has been most gratifying.

I will probably leave San Francisco Naval Shipyard Monday, stopping at Terminal Island Naval Shipyard enroute to Washington, and unless otherwise directed will return to Washington by the end of the month.

Respectfully yours,

W. S. MAXWELL

27 September 1946

Thursday, 26 September 1946:

Decontamination experiments in the Yard were reduced to two with the completion of the HENRICO and the BENEVOLENCE the day before. The two remaining experiments are the circulation of boiler compound and fresh water for four hours through copper nickel and steel pipe, and the standing test of pH solution in the salt water system of the BARTON. The boiler compound solution was circulated today for four hours (from 9:30 to 1:30) through the two types of pipe which were connected together for the experiment. Monitors readings will be reported separately. Filling of the BARTON's salt water system with pH, begun the previous evening, was completed at 0400 this morning. Lines were checked to be sure there were no leaks. After 72 hours the system will be drained and monitored.

[redacted]

UNCLASSIFIED

SAN FRANCISCO NAVAL SHIPYARD
San Francisco, 24, Calif.

Code No. (200)

[redacted]

28 September 1946

MEMORANDUM TO: Rear Admiral T. A. Solberg, USN (Code 180, BuShips)

Subject: Tests Conducted in response to directives on DesDiv 71 - USS HENRICO and USS BENEVOLENCE.

1. The enclosures present in chronological order directives and tests conducted at San Francisco Naval Shipyard on units named in the subject.

2. These data are forwarded as originally compiled and represent our preliminary draft. Due to the urgency of getting the data to you we have not held up for smoothing out. The final draft will be in a smooth form.

C. J. CATER
Captain, USN
Planning Officer

Encls:
(A) General Reports and information of Progress of Experimental Work.

(B) Laboratory Reports of Experimental Work.

[redacted]

UNCLASSIFIED

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(335)

SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO

[redacted]

7 October 1946

Subj: Report of Progress on Experimental Radioactivity Decontamination Work at San Francisco Naval Shipyard: Period 26 September - 5 October.

Enclosures:

(A) Monitor's Report on Decontamination of Auxiliary Condenser Injection Main of USS BENEVOLENCE - 26 September 1946.

(B) Procedure Used in Cleaning the Salt Water System Aboard the USS BARTON.

(C) Monitor's Report of Readings Before and After Experimental Decontamination of Salt Water System aboard the USS BARTON.

(D) Procedure Used in Cleaning; the Salt Water System Aboard the USS WALKE.

(E) Monitor's Report of Readings Before and After Experimental Decontamination of Salt Water System Aboard the USS WALKE.

(F) Monitor's Report of Examination of Floating Drydock to Determine the Extent of Contamination of the Deck Floor.

(G) Details of Valve Test in Decontaminating Chemicals.

(H) Experimental Radiological Decontamination, USS ROCKBRIDGE - Instructions for.

[redacted]

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1. In the period covered by this report, the following experimental work was accomplished.

(a) Decontamination auxiliary condenser injection lines on USS BENEVOLENCE.

(b) Decontamination of fire and flushing system on USS BARTON.

(c) Decontamination of fire, flushing and cooling system on USS WALKE.

(d) Monitoring examination of floating drydock to determine extent of contamination of deck floor.

(c) Monitor's inspection and sample sandblasting of underwater body of USS ROCKBRIDGE.

(f) Test of valves and various solutions.

(g) Work Progress on the USS ROCKBRIDGE.

2. Decontaminating auxiliary condenser injection lines on USS BENEVOLENCE:

The 16" crossover main between the port and starboard low injection valves showed very high external monitor readings (0.9 gamma). The distribution of the matter giving off emission was uneven, appearing to be concentrated in spots indicated on the sketch on the monitor's report (Enclosure (A)). There was insufficient time to remove a section of this injection line, so that no inspection was made on the interior. It was assumed that patches of sea growth was concentrating the radioactive water. It therefore seemed feasible (from prior experimental work) that introduction of steam followed by circulation of water would break up the sea growth and allow it to be flushed out. On each wing condenser the bonnets of the suction valves were lifted and blank flanges with pipe connections were substituted. The crossover main was first drained of all water. A steam line was run to the port blank and a vent line was rigged from the starboard blank. Steam was then run through the system until the temperature of the crossover main ceased to rise. (170°F.) Then valves in both the steam and bent lines were closed off and both low injection valves opened, at the same time starting the three circulating pumps. This procedure was carried on again to a pipe temperature of 195°F. before water circulation began, with no appreciable effect. The steam and vent lines were removed.

It was then decided that the only method available was to circulate muriatic acid solution through the main in order to cut the marine growth and scale loose from the pipe. A line was run from an acid mixing tank to a reciprocating air pump and hence to the pipe connection on the port blank. A recirculating line was run from the starboard blank back to the mixing tank. Inhibited muriatic acid, beginning at 2 normal concentration, was thus circulated for one hour and forty minutes. There was no time limit of circulation set beforehand. Monitors maintained constant readings of all the "hot" spots. As soon as every spot had shown changes, giving a floating reading, it was assumed that all clumps of foreign matter had been cut loose by the acid. Circulation of the acid was stopped and all acid drained from the main into barrels to be later pumped to a large container on the deck. During the circulation, the normality of the acid had dropped to 1.35 normal. Monitor readings showed only about 60% effectiveness at this stage.

Both injection valves were opened and all three circulating water pumps were started. After 15 minutes of circulation of salt water through the main, all spots showed acceptable monitor readings except one which was 0.3 gamma. Mechanical means were then resorted to in an effort to dislodge this remaining patch of foreign material. A wood block was placed on the outside of the pipe and a hammer was used for tapping. A few blows were all that were required. The reading dropped to 0.07 gamma. As of this date the low limit set for decontamination work was 0.1 gamma. Therefore, no further efforts were made. The line was drained of salt water, and then flushed with a neutralizing solution of soda ash, followed by more flushing with salt water.

The Engineering Officer of the USS BENEVOLENCE was instructed to open his auxiliary condensers one at a time to replace zincs if necessary

[redacted]

and to remove sea growth that may have lodged in the heads.

3. Decontamination of the fire and flushing system on the USS BARTON.

In order to test the feasibility of decontaminating a ship's complete fire and flushing system, the USS BARTON was selected. The monitor readings of the BARTON's system showed very low activity throughout, but since the BARTON was the only ship available at the time that had its system intact, it was planned to go ahead with this test. The steps followed in conducting this experimental decontamination are detailed in Enclosure (B). The monitor's report of readings before and after the experimental work are listed in Enclosure (C).

4. Decontamination of fire, flushing and cooling system on the USS WALKE.

The USS WALKE was set up to test the procedure of decontaminating the complete fire, flushing and cooling system of a ship, using a muriatic acid solution. A complete monitoring of the USS WALKE was accomplished and all branches of the salt water system which showed no activity were excluded in the decontaminating process by closing off root valves. The major points of difference between the BARTON and WALKE experiments was the inclusion on the WALKE of the refrigeration salt water system. The procedure used in cleaning the salt water system aboard the USS WALKE is detailed in Enclosure (D), and the monitor's report of the experiment is enclosed as Enclosure (E).

5. Monitoring examination of floating drydock to determine the extent of contamination of the deck floor:

The sandblasting in dock of the USS LAFFEY was delayed because all available manpower was on urgent tank and other drydock sandblasting; therefore, a section of deck under the part of the LAFFEY's hull that had been sandblasted was cleaned up using standard drydock procedures and the areas subjected to a monitor's inspection to determine the extent that the dock remained contaminated after cleaning. A report of this inspection is enclosed, marked Enclosure (F).

6. Monitoring inspection and sample sandblasting of the underwater body of the USS ROCKBRIDGE:

The USS ROCKBRIDGE was drydocked in Drydock No. 3 at San Francisco Naval Shipyard on 3 October. As the deck was pumped down, monitors circled the ship in a boat and took Geiger readings of the hull. From these readings they selected an area appearing to be the most active for a subsequent sandblasting test. The area selected was on the port side, Frames 40 to 60, and from the waterline down to and including the bilge keel. After pumping down, the hull was allowed to dry so as to present the worst possible condition for the sample sandblasting. This sample sandblasting was conducted on Friday, 4 October.

The sandblasters, wearing normal sandblasters' clothing and hood, and using standard wet sandblasting procedures, worked from a skipbox to accomplish the work. To windward of him in the skipbox was placed a blower having on the discharge side a 2'' heavily backed glass wool filter. This blower was tested just before the sandblasting operation, and its output checked at 530 cubic feet per minute. A second blower was set up on the dock side with a suction line led down into the dock so as to be in the way of the main dust stream floating down the dock. Sandblasting of the area was carried on for a total of 36 minutes. After the operation, filters were removed and delivered to Lieutenant Commander Skow for further delivery to Dr. Scott. It was hoped in this experiment on a badly fouled hull, such as the ROCKBRIDGE had, to show if prior scraping of the barnacles or sea growth from the hull is necessary and if blasting could be safely carried on in blasting barnacles, marine growth and paint in one operation. It was also conducted to give a further check on the results obtained in the previous experimental sandblasting of the USS LAFFEY.

7. Test of valves in various solutions:

Tests of valves to determine the amount of damage due to various solutions were conducted as an added check on observations made in using decontaminating solutions in previous experiments. These observations are summarized as follows:

(a) Piping failures in systems in which muriatic acid and ammonium citrate have been run have been due to existing weaknesses which failed because of the hydrostatic pressures imposed during the decontaminating procedure. These pressures have not been in excess of the prescribed hydrostatic tests on the elements which failed.

(b) Quantitative observation of metals immersed in the decontaminating chemicals have indicated that there is very little attack by these chemicals on the metals commonly found in salt water systems.

(c) Gasket material and packing material fails after long submergence in the decontaminating chemicals.

The results of the valve test can be summarized by saying that decontaminating solutions will not cause leaking through valves. Details of the tests are enclosed marked Enclosure (G).

8. Work on the USS ROCKBRIDGE:

This work is being very carefully planned so as to obtain the maximum of information for record and analysis. Details outlining the controls over the ROCKBRIDGE work are enclosed marked Enclosure (H). The examination of the underwater hull and the sample sandblasting are complete. Organization of the salt water piping and of the evaporator decontamination should finish 9 October and actual decontamination should start the same day.

PHILIP LEMLER
Captain, USN
Production Officer

[redacted]

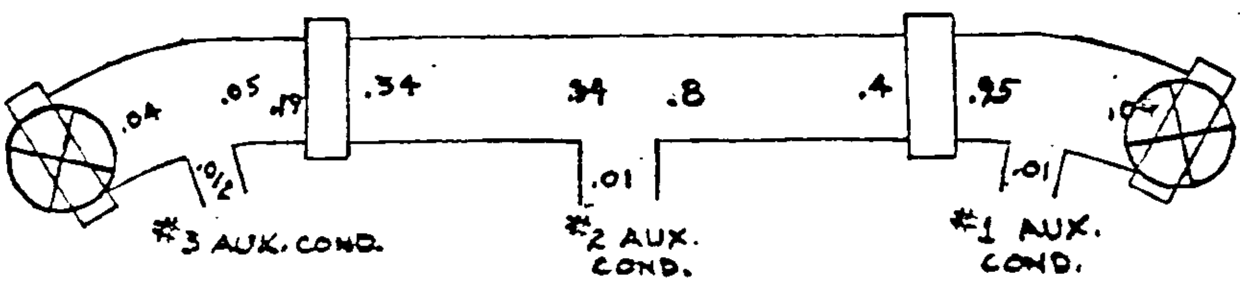
26 September 1946

PLASTIC LINED PIPE - ACID TREATMENT

USS BENEVOLENCE

Clearance of Sea Suction lines in Auxiliary condenser space. Cold shock and acid.

1. Radiological condition of 16 inch sea suction line before treatment. Readings in R/24 hrs of gamma.



2. Treatment

(a) Cold shock - Steam heated to 170° followed by cold water. No change in readings.

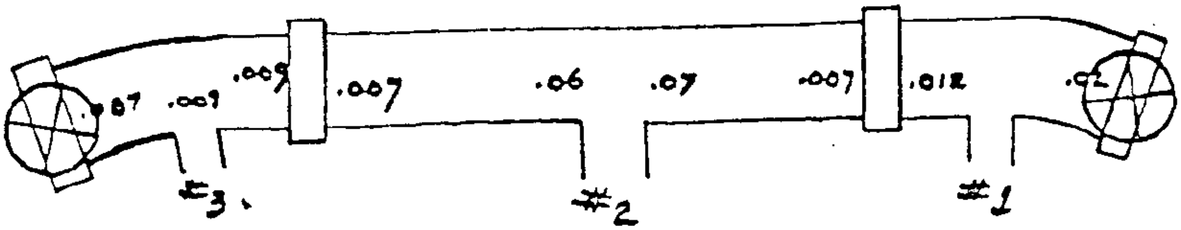
(b) Cold shock - Steam heated to 190° followed by cold water. No change in readings.

(c) 2 Normal Hcl circulated through section from inlet at #3 auxiliary condenser to outlet at #1 auxiliary condenser. Readings in acid increased to .12 R/24 hours gamma and greater than .5 R/24 hours beta and gamma. Acid was pumped out and stored in tanks. Pipe section flushed with salt water five minutes, then neutralized with soda ash and reflushed.

Encl. (A)

[redacted]

3 Readings at completion of treatment as follows:



4. Summary of readings as follows: (all outside readings).

	Before Treatment	Acid in	Acid removed (not flushed)	Flushing Completed
Sea valve port	.04	.036	.036	.007
At #3 condenser	.06	.08	.06	.007
Outboard of Port expansion	.19	.29	.24	.009
Inboard of Port expansion	.34	.4	.24	.007
#2 condenser	.34	.4	.34	.08
Stb'd #2 cond.	.8	.7	.45	.07
Inboard Stb'd expansion	.4	.5	.45	.007
Outboard Stb'd expansion	.36	.8	.40	.012
Stb'd sea valve	.04	.08	.03	.02

5. From the readings with the acid in the pipes it is obvious that the activity is moved about in the pipes by the acid before it is finally removed.

During the flushing it was shown that mechanical action, such as light tapping with a carpenters mallet aided in removal of some of the activity whereas it was of no assistance in the flushing following cold shock.

Encl. (A)

[redacted]

6. It is obvious that the acid removes some of the activity and loosens or prepares the remainder which is removed by flushing and neutralization.

W. A. CHADBOURN
Lt. (MC) USN

Encl. (A)

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MEMORANDUM

Subject: Procedure Used in Cleaning the Salt Water System Aboard the USS BARTON.

1. The following steps were used in cleaning the fire and flushing system aboard the USS BARTON.

a. The system was completely monitored, dropping valves necessary to obtain significant readings. In spite of the prevalent low readings throughout the system it was decided to test the procedure of cleaning the entire fire and flushing system.

b. A 500 gallon steel mixing tank was placed on the superstructure deck from which piping was run in the suction side of No. 3 fire and flushing pump in the after fire room. A riser approximately 100 feet from the fire and bilge pump was tapped to connect a recirculating line to lead back into the mixing tank.

c. The fire and flushing systems were drained at the drain connection of the fire and flushing pumps in the two engine rooms. It was necessary to open outlets to allow air to enter the system and effect complete drainage.

d. The double strength ammonium-citrate was mixed in the mixing tank and pumped into the fire and flushing system by No. 3 fire and flushing pump. Outlets were cracked until flow of liquid began. As each line was filled the outlet was closed. Upon complete filling of system all outlets were closed, since the ship needed no head in operation. On ships where it is necessary to provide head facilities for the crew one outlet can be let run continually. The solution was let stand in the system for periods ranging from 64 to 90 hours, legs being drained at intervals, for spot checks. At the end of 90 hours the entire system was drained from the drain connections, the drainage being collected in containers and pumped into a large tank on the deck side.

Encl. (B)

[redacted]

UNCLASSIFIED

e. It was felt that chemical reaction on the growth inside piping would cause gaseous bubbles to form around the very material which was necessary to remove. Since circulation for the complete system from all outlets is impractical it was decided to maintain a surging pressure on the system by means of a small recirculation system so that the fire and bilge system could be continually run. This was done during the period that the ammonium-citrate was in the system. The object of this procedure was to break down or eliminate gaseous pockets.

f. To effect complete removal of cleaning fluid in the system air suction was taken by the fire and bilge pump and pressure put on the fire main. This purged the system by air. The system was then filled with salt water and circulated for a short period. This is not considered necessary and will not be repeated in future work of this nature. The salt water was drained out and the system again purged by air. The succeeding steps consisted of mixing a neutralizer solution of soda-ash (boiler compound) in the mixing tank and filling the system completely through No. 3 fire and bilge pump. This was allowed to stand 30 minutes and then was drained out and pumped overboard. The system again was purged by air. The final step was to take suction out of the sea chest and flush all outlets with water, each outlet being run approximately 1/2 hour. Monitor readings showed drops to practically zero in all places noted previously. These readings, are being reported separately.

2. One item of note is the fact that leakage around packing in valves and pumps developed after the ammonium citrate solution had stood 50 hours.

M. E. TURNBAUGH

Encl. (B)

MONITOR'S REPORT 1 October 1946

FIREMAIN DECONTAMINATION STANDING CITRATE SOLUTION

USS BARTON

Initial readings were made on the salt water fire and flushing system of the Barton on Wednesday of last week with an X-263 meter. Early Thursday morning these same lines were pumped full of solution.

The initial set of outside readings showed such a low level of radioactivity that several valves were dropped in order to obtain readings. Comparison of "before" and "after" treatment readings shows that in only three places did significant changes occur. In view of the fact that initial outside readings were so low, no readings taken during the time the solution was in the lines were found to be significant. In the valves for which readings are shown, the solution was allowed to stand for 92 hours.

The eleven valves which were dropped were lettered A thru K from the aft end to the forward end of the ship.

All readings shown are gamma plus beta and were taken on lines from 1 to 4 inches inside diameter.

		BEFORE TREATMENT	GAMMA	AFTER TREATMENT
Value	A	0.002 -	0.000	0.002
	B	0.017 -	0.002	0.009
	C	0.084 -	0.008	0.003
	D	0.002 -	0.000	0.000
	E	0.002 -	0.000	0.007
	F	0.006 -	0.001	0.006
	G	0.072 -	0.007	0.006
	H	0.003 -	0.000	0.002
	I	0.002 -	0.000	0.002
	J	0.001 -	0.000	0.000
	K	0.005 -	0.000	0.002

Encl. (C)

[redacted]

All valves and lines inspected were found to be free of marine growth and scale, save a few places where small numbers of barnacles were found.

The rise in radioactivity at value E possibly was caused by the collection at that point of a small amount of sludge which did not drain from the line.

More information is shown below on the three valves in which significant lowering of activity occurred.

AFTER TREATMENT

VALVE B

Location : C-204LM (Crew's Sleeping Compartment)
Size : 3" inside diameter line
Material : Copper-Nickel
Readings : Open ends of both pipe section on either side of valve-----0.004

Open ends of valve-----aft-----0.007
fwd----0.009

Nothing in line but small amount of sediment

VALVE C

Location : Fire main in aft engine room against aft bulkhead on starboard side.
Size : 4" inside diameter line.
Material : Copper-Nickel
Readings : Open ends of both pipe sections---0.003
Open ends of valve--------------0.003

Piple completely free of growth and sediment.

Encl. (C)

VALVE G

Location : A-205-L (Crew's Mess), fire main.
Size : 4" inside diameter line.
Material : Copper-Nickel
Readings : Open ends of both pipe sections. -----0.004
Open ends of valve. ----------------0.006

A few small barnacles, no other growth or scale.

After the solution was drained from all the lines it was discovered that the solution had not passed through valve F. This happened because a leaky valve made it necessary to close-off this section of line. A few feet lower down on the same line, next to a fire and bilge pump, another valve was removed and found to read 0.3 gamma plus beta.

J.R. H. WILSON
Monitor

Encl. (C)

[redacted]

SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO 24, CALIFORNIA

[redacted]

MEMORANDUM

Subject: Procedure Used in Cleaning the Salt Water System Aboard the USS WALKE.

1. The following steps were used in cleaning the salt water system aboard the USS WALKE.

a. The system was completely monitored, dropping valves necessary to obtain significant readings. The system originally had very low activity readings.

b. A mixing tank was placed on the superstructure deck from which piping was run into the suction side of No. 3 fire and bilge pump in the after fire room. A riser approximately 100 feet from the fire and bilge pump was tapped to connect a recirculating line to lead back into the mixing tank.

c. The fire flushing systems were drained at the drain connection of the fire and flushing pumps in the engine room. It was necessary to open all outlets to allow air to enter the system and effect complete drainage.

d. One (1) normal inhibited muriatic acid was mixed in the mixing tank and pumped into the system by the No. 3 fire and bilge pump. Outlets were cracked until flow of liquid began. As each line was filled the outlet was closed. When the entire system was filled, all outlets were closed and circulation was begun. The acid control information was as follows:

Encl. (D)

[redacted]

1. Circulation was begun at 1230
2. Circulation was stopped at 1545
3. Readings of the acid were as follows:

   a. 1.1 normal at 1300
   b. 1.02 normal at 1400
   c. .95 normal at 1515
   d. .93 normal at 1545

e. It was felt that chemical reaction on the growth inside piping would cause gaseous bubbles to form around the very material which was necessary to remove. Since circulation for the complete system from all outlets is impractical it was decided to maintain a surging pressure on the system by means of a small recirculation system so that the fire and bilge pump could be continually run. This was done during the period that the acid was in the system. The object of this procedure was to break down or eliminate gaseous pockets. When samples were taken from the lines where there was no circulation. It was found that the normality of the acid was very low, (0.4 normal)

f. The acid solution was removed from the system in the following manner:

1. The recirculation hose which was discharging into the mixing tank was led into the collecting tank on the dock side. By running #3 F and B pump back suction was placed on the firemain and a portion of it cleared of acid.

2. The recirculation hose was then conncted to the suction side of #3 F and B pump and the pump ran 15 strokes. This pulled acid into the suction mains of the pump. Then the recirculation hose was led to the collecting tank and the #3 F and B pump ran, this acid was discharged. This process was repeated about 20 times.

3. Then men were stationed at all plugs. Air suction was taken on the F and B pump, placing pressure on the mains. Valves on the plugs were opened, and all acid collected in buckets.

Encl. (D)

[redacted]

4. The refrigeration cooling system was drained by removing the cap on the plug in the overboard discharge, and the acid collected in a container setting in the floor of the drydock.

g. After the system was flushed with water, it was purged with air and filled with a neutralizing solution of Soda Ash. This was circulated through the system for about thirty minutes, let stand overnight and then was pumped overboard. The system was again purged with air and flushed very vigorously and completely with water. Hoses were put on all outlets in order to complete a thorough flushing. The monitor readings for this experiment will be reported separately.

2. As far as can be determined there was no damage caused to the system.

3. A total of 26 men and 2 officers completed the above process in a total of eleven hours.

MONITOR'S REPORT 7 October 1946

Fire Main Decontamination Circulated Acid Solution

USS WALKE

In Hcl inhibited was circulated thru the fire mains of the ship on Friday, 4 October 1946. Later the acid was dumped, followed by circulation of the neutralizer and flushing.

Radiation readings were taken before the acid treatment and today.

Sections of fire main:

before -	.014	.021	.07
after -	.007	.007	.012

Some bonnets were removed from valves along with a section of fire main, read and photographed prior to the test. Today after the acid treatment the procedure was repeated.

Fire and Flushing pumps	Before	After
#1	.004 .06	.001 .002
#2	.004 .08	.002 .007
#3	.001 .012	0
Fire and Flushing lines		
Fwd. eng. rm.	.005 .017	0
Aft. eng. rm.	.012	0

Encl. (E)

[redacted]

Valve to magazine sprinklers		
In C - 03	.001	0
	.005	.001
In C - 04	.001	0
	.005	.001
Section of fire main in		
C - 08 (inside)	.008	0
	.15	.005
(outside)	.005	0

J. COLEMAN
Monitor

Encl. (E)

22 September 1946

MONITOR'S REPORT

DRYDOCK DECONTAMINATION

The USS LAFFEY docked in the ARD-32 at San Francisco Naval Shipyard has been undergoing hull sandblasting. To date sandblasting is only about 15 percent complete.

A preliminary study was made to determine the problems involved in decontaminating the deck of this dock.

An area was chosen near frame 140 of the ARD, which is the position of the USS LAFFEY's Propellers. Sandblasting had been carried out in this area on ship's sides as well as some chipping and scraping of the bottom and propellers. The deck of the ARD was covered with one-fourth inch of wet sand. A fifteen foot square area was swept down with brooms and radiation readings taken. This same area was next flushed with a fire hose for two and one-half minutes and readings again taken. Results are shown below.

(a) Beta readings on 15 feet square area before removal of collected blast sand:

R/24 hrs.	-X863	1/2 inch from source
.000	.004	.004
.007	.004	.004
.005	.004	.004
.005	.004	.004
.005	.004	.004

Encl. (F)

[redacted]

(b) after removal of collected blast sand with stiff brushes:

R/24 hrs.	-X263	1/2 inch from source
.007	.003	.003
.005	.003	.003
.004	.003	.003
.005	.003	.005
.004	.003	.003

(c) after flushing down for 2-1/2 minutes with fire hose:

R/24 hrs.	-X263	1/2 inch from source
.002	.0017	.0017
.008	.0017	.0017
.0015	.0017	.0015
.0015	.0015	.0015
.0015	.0015	.0015

Discussion:

On the area described above a section of the hauling block way was included. This afforded a check on crevices and irregular surfaces. Decontamination was equally effective here as on the flat rusty steel deck area.

A wooden keel block presenting a flat surface area four feet square was checked before and after a 2-1/2 minute fire hose flushing. The average surface reading in Beta R/24 hrs. before flushing was .008 and after flushing .002. The instrument background reading was .001. Hence, on wooden surfaces as might be expected decontamination is not as good as on steel decking.

Conclusions:

From results obtained on this test area, it appears that a short period, two and one-half minutes, of vigorous water flushing will result in excellent and satisfactory decontamination of steel drydocks.

[redacted]

Encl. (F)

UNCLASSIFIED

LABORATORY TEST RESULTS

SAN FRANCISCO NAVAL SHIPYARD

8 October 1948

Report Number 388-4260-48

Material The Effect of Decontaminating Solutions on the Water-Tightness of Valves.

1. Four stock valves were selected and tested for water-tightness. Two of the valves were steel globe type and two were bronze gate valves. These valves were immersed in the various solutions listed below, removed, and tested hydrostatically, at the intervals listed in Table 1. The actual composition of the seats was not determined. One steel valve had steel seats while the other had bronze seats. The bronze valves had copper alloy seats. The temperature of the solutions varied between 60 and 80 degrees Fahrenheit.

2. It appears that the addition of the inhibitor (Turco-Acryl, S. P.1) specification 51 I 2, Type B, Class a, in the concentration of 1% by volume of the amount of commercial Hydrochloric acid present gives satisfactory protection for a reasonable period of time. It is not recommended that uninhibited acid be used on steel valves. It should be pointed out that circulation will increase the action of the acid on valves.

3. It is also recommended that additional or repeat tests be conducted on six valves. These valves should include three with steel seats and three with bronze seats, and that the solutions used should include ammonium citrate solution, in addition to inhibited and uninhibited hydrochloric acid. Pending the information to be obtained from this recommended test, it is the opinion of the laboratory that bronze and steel valves can be exposed to inhibited 1 normal hydrochloric acid for a period up to four hours without serious damage to the valves.

JOHN E. HOWELL
Asst. Shop Supt for Laboratory

ENC: Table 1

G. M. GORDON

Enc. (G)

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TABLE I

VALVE	SOLUTION	CHECK AFTER 4. Hrs.	CHECK AFTER 8 Hrs.	CHECK AFTER 26 Hrs.	CHECK AFTER 179 Hrs.
BRONZE GATE	Hydrochloric Acid 1 N	Seepage at 100#	Seepage at 100#	Seepage at 100#	Small leak at 100#
BRONZE GATE	Inhibited Hydrochloric Acid 1 N	Good at 100#	Seepage at 100#	Good at 100#	Small leak at 100#
STEEL GLOBE (Bronze Seats)	Inhibited Hydrochloric Acid 1 N	Good at 100#	Good at 100#	Good at 100#	Good at 100#
STEEL GLOBE (Angle)	Hydrochloric Acid 1 N	Good at 100#	Good at 100#	Good at 100#	Bad leak withheld no pressure

Observations as to conditions made by Lt. K. M. Culver, Ship Supt.

SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO 24, CALIFORNIA

[redacted]

7 October 1946

From: Senior Bureau of Ships Crossroads Representative, San Francisco
To: San Francisco Naval Shipyard

Subj: Experimental Radiological Decontamination, USS ROCKBRIDGE (APA228)

1. The USS ROCKBRIDGE (APA228) will be decontaminated to accomplish the following results, if possible:

(a) Upon completion of the decontamination process, the vessel should be granted complete radiological clearance.

(b) The data taken during the work on the vessel should furnish the information necessary to arrive at a standard by which it may be determined:

(1) When it is necessary to decontaminate.
(2) When the decontamination process is complete.

(c) A firm procedure should be developed which may serve as a model for future ships and other Yards.

(d) All radiological safety precautions currently in force will be tested for their efficiency and pertinence.

2. Experience has shown that the following locations aboard ship contain all of the contaminators aboard non-target vessels.

Encl. (H)

[redacted]

(a) The exterior of the underwater body of the ship and small boat hulls.

(b) The salt water system, firemain and flushing.

(c) Evaporators, salt water sides, and piping.

(d) Miscellaneous heat exchangers, using salt water as a cooling medium, such as lube oil coolers, freon condensers, boat engine cooling system, etc.

(e) Main and auxiliary condensers.

The above grouping of the contaminated areas of the ship is made in view of the fact that each group requires a distinct treatment. The nature and extent of any contamination could be expected to be roughly the same within each group.

3. The steps in which the work will be accomplished on each system will be as follows:

(a) Monitor each system completely. The senior monitor at the Shipyard is assigned the responsibility of outlining the procedure to be used that all readings taken and recorded may be identified. The procedure should be laid out and recorded in such a manner that it may be duplicated on any ship or by any monitor. The data that must be taken with each reading will be specified in consultation with the University of California Laboratory representative. The aim of the radiological survey is, in conjunction with the other data obtained, to prove that it is or is not practicable to grant complete radiological clearance on the basis of Roentgen readings alone.

(b) Samples will be taken from each system. Where practicable they will be taken at the location of the highest readings for the particular system involved. In general they will be taken before and after decontamination, and of the materials removed.

[redacted]

The samples with complete data will be delivered to the University of California laboratory for qualitative and quantitative analysis.

(c) The Shipyard will estimate the total amount of materials similar to the samples on the ship.

(d) The Shipyard, assisted by ship's force, will apply the approved decontamination procedure to the system. Upon completion, withdraw samples of materials removed and dispose of the remainder as per current instructions. During decontamination make an analysis of the methods employed to determine the safety precautions required.

(e) Completely resurvey the ship in a manner similar to step (a) above. Resample as in (b).

(f) On the basis of the above data, calculate for each system the amount of the contaminators present before and after decontamination and the amount removed.

The facts as ascertained will be forwarded to BuMed and BuShips with all pertinent recommendations.

4. Below for each system are enumerated amplifications and applications of the steps outlined above to each system:

(a) Hull exterior.

(1) Complete survey. In the survey of the underwater body, it is desirable to obtain an accurate idea of the distribution of the contaminated area of the ship bottom. The data taken will include the following:

a. Condition of the paint
b. Thickness of the paint
c. Whether or not there is rust under the paint
d. Amount, distribution, and types of fouling.

(2) Taking of samples. The samples taken will consist of: Marine growth from a given area of the bottom showing the highest reading. From this same section in each case the paint will be carefully scraped off and also serve as a sample. Rusted areas which may show similar high readings will also be removed for a sample. Non-fouled painted areas showing the highest readings will be scraped off carefully as a sample.

The idea of the samplings and their subsequent analysis will be to determine, if practicable, if the decontamination procedure could be stopped after the removal of marine growth and/or possibly the removal of the rusted areas where no marine growth is present. Failing in this, answering the question whether or not it might be possible to decontaminate the ship by applying the wet sandblasting to specified and limited portions of the bottom.

(3) The Shipyard will calculate or estimate the total underwater area of the ship and the amount of each sample present on the ship.

(4) Decontamination, The Shipyard will

a. Scrape the marine growth from the sides of the ship while wet.

b. Wet sandblast in the normal fashion.

c. Dispose of sand and marine growth removed.

During the sandblasting, the experiment using the filter queen or equivalent shall be repeated while working the worst contaminated areas to check on industrial safety. By use of the filter queen, an experiment will be conducted to determine if any hazard exists in allowing the bottom to become dry and material exfoliating due to wind. This may be done by allowing a rather small section of the bottom to become completely dry, fitting up the filter queen down wind from the dry area and then directing a compressed air stream against the dry ship with a force simulating a high wind and collecting any particles removed.

(5) The resurvey will be made, in general following the procedure used on the initial survey. It will probably be impracticable to remove any samples after the sandblasting.

(6) By the use of the data obtained in this process, it should be feasible to recommend to the Bureau of Medicine and Surgery a limit of Roentgen readings, which, if an undecontaminated ship should have, no drydock work would be necessary. By the use of the data obtained by the filter queen, a similar recommendation can be made relative to the current safety precautions. From the surveys and sampling, it should be determined whether or not it is feasible to wet sandblast small areas which show contamination and give complete radiological clearance.

(b) Salt water piping.

(1) Radiological survey. Methods to be formulated as in paragraph 4(a)(1) above. The aim of the operation is to take scientific data whereby from readings taken on the outside of piping we may set a lower limit for determining the necessity of conducting any decontamination procedure.

(2) Samples. The samples will be taken where possible in the most contaminated spots and will consist of:

a. Scale and marine growth
b. Suitable whole length of pipe
c. Samples of material, acid sludge mixture removed.

[redacted]

(3) a. The Shipyard will furnish an estimate of the total amount of scale or marine growth present in the pipe lines.

b. An estimate of the interior surface area of the salt water system.

c. The Shipyard will also measure the amount of scale, marine growth and sludge removed from the salt water system by the acid treatment.

(4) Decontamination. The decontamination procedure for salt water piping will be to fill the system entirely, including all branches showing any Roentgen reading above background with the ammonium citrate solution recommended by the University of California or the HCL solution. The selection will be made on the basis of the amount of marine growth present in the pipe lines. Suitable temporary areas will be employed to obtain a certain amount of circulation of the acid. Suitable instructions will be furnished by the Yard to the ship to enable the ship to assist in this process to the maximum extent practicable. The acid, together with any sludge removed from the pipe lines, will be drained, sampled, and measured before being readied for disposal.

(5) The system will then be resurveyed and samples similar to those taken in (2) will then be taken and delivered to the University of California. With the use of these samples and the other data, an estimate will be made of the total amount of contaminators remaining.

(6) The complete data will then be forwarded with recommendations to BuShips and BuMed relative to complete radiological clearance.

(c) Evaporators. The steps in decontamination of evaporators will follow the same pattern as outlined for the hull and the salt water system. The actual decontamination procedure to be followed will be that presently authorized by the Bureau. Sufficient samples will be taken to ascertain if it is feasible to clear an evaporator on the basis of Roentgen readings alone.

(d) Condensers. The same [illegible] and samples will be taken of one main and one auxiliary condenser as for any other system. No decontamination other than that currently approved will be undertaken.

(e) Heat exchangers. Same as evaporators.

W. S. MAXWELL
Captain, USN

CC: Dr. Scott, U. of C. Laboratory
Captain Walsh, 12th N.D. Med. Off.
Captain Winn, 12th N.D. Operations
Captain Quarton, 19th Fleet Material Office

[redacted]

Code No. (330)

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

18 October 1946

MEMORANDUM

Subject: Progress of Radioactive Decontamination at San Francisco Naval Shipyard.

Enclosures: (1) Monitoring Survey of Underwater Body of USS ROCKBRIDGE on Drydocking (3 October).
(2) Monitor's Report of Experimental Sandblasting of Hull - USS ROCKBRIDGE (4 October).
(3) Estimate of Total Radioactive matter on USS ROCKBRIDGE - Information for (14 October).
(4) Report of Experiment in Decontamination of Under-water Body - USS ROCKBRIDGE (14 October).
(5) Report on Experimental Decontamination Work on the Salt Water Lines - USS ROCKBRIDGE (15 October).
(6) Decontamination of Evaporator Unit on USS WALKE (DD723) (15 October).
(7) Report on Decontamination of Evaporators - USS ROCKBRIDGE (16 October).
(8) Report on Experimental Decontamination of Auxiliary Condenser on the USS BOTTINEAU (16 October).
(9) Decontamination of Condensers - USS WALKE (17 October).

1. The following ships which took part in the Bikini operation at present are at the San Francisco Naval Shipyard.

USS WALKE (DD723)	
USS LAFFEY (DD724)	Destroyer
USS BARTON (DD722)	Division
USS LOWRY (DD770)	71
USS O'BRIEN (DD725)	

[redacted]

USS BOTTINEAU (APA235)
USS ROCKBRIDGE (APA228)
USS ROCKWALL (APA230)
LST-881
ACHOMAWI (ATF148)

2. Completed reports of work on the above ships are herewith enclosed. All ships are making lists of items and systems requiring decontamination, based upon the Radiological Safety Officer's monitoring of the ship. Such lists are being submitted as work requests. In the main the work requests call for material and equipment to be furnished by the Shipyard. All work is being performed by the ships, subject to inspection and advice from the Shipyard.

3. All decontamination work is progressing satisfactorily on ships of Destroyer Division 71. It is planned to have the first of these ships cleared by the Radiological Safety Officer by 22 October. A complete monitor list for the ship will then be submitted for final clearance.

4. The USS ROCKBRIDGE has completed the salt water mains, evaporators, and sandblasting. Readings and experimental samples, in accordance with instructions from the Bureau of Ships, have been submitted for study to the Research Radiation Laboratory at the University of California. From this data, a calculation will be made to determine the total amount of radioactive matter on the ship.

5. The USS BOTTINEAU is procuring blanks and equipment from the USS ROCKBRIDGE as soon as each item is finished, and is setting up for decontamination.

6. The USS ROCKWALL was furnished instructions, material, and equipment, and proceeded to sea on 16 October for decontamination of their salt water lines and evaporators. An experienced Ship Superintendent assisted the ship at sea. The USS ROCKINGHAM, berthed temporarily at the Shipyard, was similarly provided for. Both ships completed the work and returned to port after 30 hours.

[redacted]

7. The LST-881 completed monitoring 17 October. Actual work of decontamination should start 21 October.

8. The ACHOMAWI (ATF-148), as shown by a complete monitoring survey, has less contamination than expected. All cordage, canvas, wood, boats, etc., was disposed of at sea. Only a few miscellaneous items have monitor readings significant enough to warrant experimental decontamination (2 fire hoses, paint, etc.). The salt water lines require considerable repair work before decontamination can proceed. The evaporator unit was not used at Bikini and shows no radioactivity. The ship is being listed this date to obtain waterline monitor readings. Dry-docking is scheduled for 21 October. Both the ACHOMAWI and the LST-881 will have the same samples taken as the USS ROCKBRIDGE to permit a detailed analysis to be made.

PHILIP LEMLER
Captain, USN
Production Officer

[redacted]

October 3, 1946

Subject: Monitoring Survey of Underwater body of U.S.S. ROCKBRIDGE on Drydocking.

1. Readings taken in drydock as water was pumped out. Due to rapidity at which water receded, the availability of only one row boat, and the necessity for obtaining readings on both the ROCKBRIDGE and BOTTINEAU more extensive readings were not recorded. Only representative readings are listed. Readings were taken continuously but recorded at every 2nd weld alongside unless reading varied appreciably from surrounding areas. Hull was wet and readings were taken on contact with skin of ship at water line or slightly below.

	Gamma	Gamma plus Beta
Rudder and Screw	2 x background	.009
#1	2 x background	.006
#2 stbd.	background	.003
#3 stbd.	background	.007
#4	background	.002
#5 (heavy growth)	background	.007
#6	background	.003
Bow, (rusted area)	2 x background	.019
#7 (6 ft. below W.L.)	background	.012
#8 (Port)	background	.014
#9	background	.005
#10 (heavy marine growth)	background	.016
#11	background	.008
#12	background	.007
#13 (screw)	2 x background	.009
#14 (12 ft. below W.L. heavy rust area and marine growth about fr. 60	2 x background	.025
#15 (Sea strainer about Fr. 70)	2 x background	.040
(Along keel and 2 feet water level stbd.)		
Rudder and screw	background	.003
#16	background	.004
#17	background	.004
#18	background	.005

[redacted] Enc. (1)

	Gamma	Gamma plus Beta
#19	background	.003
Stabilizing fin	2 x background	.03
#20	background	.007
#21	background	.006
#22	background	.005

2. Readings on hull will be 3-6 times higher when dry. See readings taken on experimental sand-blast area the following day.

3. Probably the most representative 20-ft. strip for experimental blasting would be on portside frame 50-70. The area should include a portion of the stabilizing fin. The readings in this area range from .007 to .03 (wet). When dry the readings will be approximately three times the above. The rust spots and areas with heavy barnacle formations approximate closely to the .03 reading.

Enc. (1)

MONITOR'S REPORT

4 October 1946

EXPERIMENTAL SANDBLASTING OF HULL

USS ROCKBRIDGE

Experimental Set Up

A 20 x 20 ft. area on port side, previously determined as a representative of the worst condition available on hull of USS ROCKBRIDGE, was designated for the experiment. The area was monitored and 1 ft. sq. (surface area) samples taken at the waterline Frame 70, at sea strainer Frame 71 just above stabilizing fin, at heavily rusted area about Frame 60, 6 ft. water level, and Frame 63 at 10 ft. water level. The procedure used on collecting the samples was as follows:

(1) 1 Sq. Ft. area marked off
(2) Monitored for Beta plus Gamma
(3) Superficial Contamination removed by scraping material collected
(4) Monitored again for Beta plus Gamma
(5) Deeper contaminated material removed to the metal and material collected.
(6) Cleaned area monitored again for Beta plus Gamma

Sandblasting of the area was then carried out with a blower placed next to sandblaster so as to collect as much of the dust as possible in area of worker. Another blower was placed on deck of drydock to collect the dust, at that point. The material collected by these blowers was passed through a filter of glass wool which will be monitored subsequently and samples of dust sent to laboratory for analysis. An estimate of surface area covered by rust and heavy marine growth will be calculated by the repair superintendent's representative.

Following the sandblasting the area was monitored again to determine residual activity and samples taken.

[redacted]

Enc. (2)

All samples will be analyzed at Radiation Lab. at University of alifornia.

The following are the readings and descriptions of areas before sandblasting.

Sample and Location	Description (All samples taken from 1 sq. ft. area)	Reading
		Before .192 Beta pl. Gamma
#1 Frame 70 waterline	Superficial scraping of rust	After .048
#2 Frame 70 waterline	Deep scraping of rust and paint	Before .048 After .016
#3 Sea strainer Frame 71	Superficial scraping heavy marine growth and rust	Before .5 After .38
#4 Sea Strainer Frame 71	Rust and some marine growth	Before .38 After .31
Frame 60 3 ft. above stabilizing fin.	Heavy rust and some marine growth Superficial scraping	Before .22 After .14
#6 same	deep scraping of rust and paint	Before .14 After .0050
#7 8 ft. below	superficial scraping light rust and fine Marine growth	Before .036 After .024
#8 same	deep scraping paint and some rust	Before .024 After .005

[redacted]

Enc. (2)

READINGS ON THE EXPERIMENTAL AREA AFTER SAND BLASTING WERE BACKGROUND B. AND G.

Following the sandblasting, samples of sand were taken from the areas on the drydock deck directly below the blasted area. These samples were Nos. 9, 10, and 11. Readings of this sand varied from .002 - .005.

The filters from the two suction blowers were sent to the lab. for analysis.

LT. E. W. BARNS (MC) USN

Enc. (2)

[redacted]

UNCLASSIFIED

14 October 1946

Subject: Estimate of total radioactive matter on USS ROCKBRIDGE; Information for.

1. In order to make a calculation for total radioactivity on the ship, it was necessary to:

(a) Take representative samples from various systems for study at the radiation laboratory and for determination of the total amount of radioactive matter in the samples.

(b) Assign to each sample the area that it represents.

(c) Provide the total area of contaminated surfaces on the ship.

2. Samples were taken in high reading spots in the system as follows:

LOCATION	AREA REPRESENTED
Elbow from Overboard of Auxiliary Condenser No. 2	30.
Valve from Lube Oil cooler inlet No. 1 generator	2.5
Elbow from overboard of Auxiliary condenser No. 1	35.
Valve from Lube Oil cooler No. 2 generator	2.5
Valve from Lube Oil cooler Inlet No. 2 Generator	2.5
Valve from Lube Oil cooler outlet No. 1 generator	2.5
Sea suction strainer No. 1 assembly	16.
Salt water manifold to refrigerator from No. 1 valve	1.5
Cut Off to reducing valve outlet 2-63	2.5
Sea Suction strainer assembly No. 2	16.
Cut Off to reducing valve outlet 2-63	2.5
Reducing Station, sanitary system from 2-97-1.	1.5
Sanitary system, Reducing valve, 2-63	6.
Connecting line between fire pump discharge and manifold to refrigerator unit	2.
Evaporator, Unit #2, Second effect Unit #2, sump.	470.
Evaporator Unit, First effect Unit #2, sump.	470.
Evaporator Unit, No. 1, First effect sump	470.

[redacted]

Enc. (3)

UNCLASSIFIED

USS ROCKBRIDGE

LOCATION	AREA REPRESENTED
Marine growth - underwater body - Fr. 70	20,000.
Barnacles ” ” Fr. 60	30,000.
Rust ” ”	1300.
Sand in bottom of dock (after sample sandblasting)	125 Tons

3. Total contaminated areas for the various systems and other pertinent information necessary for application, of data from samples to the end that the total amount of radioactive matter on the ship might be estimated are given as follows:

Evaporator Plant
1,880 sq. ft.

Main Condenser
7,900 sq. ft.

Fire, flushing and cooling system
22,800 sq. ft.

Lube Oil Coolers
407 sq. ft.

Auxiliary Condenser
3000 sq. ft.

Total salt water surface - Interior
35,888

Total exterior of Hull - Keel to top of bulwark
70,000 sq. ft.

Total Vertical Exterior
surface exposed (superstructure)
5,280 sq. ft.

Total Horizontal Exterior
surface exposed (superstructure)
10,240 sq. ft.

Enc. (3)

[redacted]

Weight and Volume of Marine Growth and Rust on Underbody of USS ROCKBRIDGE (APA 228)

		Wt.	Ft.^2
Barnacles	Keel up to 14' weight loading	2640#	30,000 Ft.^2
Marine Growth	14' up to 16' Weight Loading	84#	20,000 Ft.^2
Rust	16' up to 17' W.L. plus 1% of Hull	260#	1,300 Ft.

SAMPLES TAKEN:

18 Ft.^2 Barnacle scrapings	weigh	349	grams	--.088#/ft.^2	of	hull	scraped
6 ft.^2 Marine Growth	"	"	56	"	--.042#/ft.^2	"	"	"
6 ft.^2 Rust	"	"	270	"	--. 20#/ft.^2	"	"	"

CONDITION OF PAINT:

Below Water Line - Poor
Above Water Line - Poor
Thickness of Paint - 1/32"
Rust - 1300 sq. ft.

LT. J. E. HOWELL

Enc. (3)

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

MEMORANDUM

14 October 1946

Subject: Report of Experiment in Decontamination of Underwater Body - USS ROCKBRIDGE

PURPOSE

The purpose of the experiment was a first attempt in an endeavor to find an easy, cheap method of removing contamination from the hull, if possible, without removing the paint.

METHOD

An area of the hull about three feet on a side was chosen which showed maximum activity. On 9 October (AM) each vertical half of this area received an application of a solution by brush. One solution consisted of 1N HCl, 5% $CaCl_2$, and 20% starch; the other solution was ammonium citrate (pH solution 2 times strength), 5% $CaCl_2$ with starch to make a paste. Approximately 6 hours later the lower transverse half of the area was washed with salt water under pressure, readings before and after being recorded. The top transverse half was left alone until 11 October (AM) when it was washed down with salt water under pressure, readings again being taken before and after.

A small area was also outlined, for control, which received only the salt water wash down.

RESULTS

The results of the area receiving the chemical treatment are shown on the inclosed outline. The central area dropped from 0.033r/day to 0.017 r/day after the salt water wash down. Generally the chemical treatment did not appear to effect any greater reduction

[redacted]

of activity than the plain salt water pressure wash. The citrate area in the upper right hand corner showed sufficient removal of contamination. However, in this case the starch solution had so hardened in standing for a day that it would not wash off and had to be removed by mild rubbing with a cloth. The indicated zero readings mean one to several times background.

REMARKS

The results indicate that the treatment with HCl is no more efficient than that using plain salt water. The citrate solution when removed immediately also showed the same level of effectiveness. However, when it had been allowed to stand and was rubbed off, marked reduction in activity occurred. If a citrate solution could be prepared that would stay wet when allowed to stand for a day it possibly would effectively reduce the activity.

The various readings were taken with the Model 263 Geiger Muller counter. The indicated differences in the readings at the various stages cannot be regarded as quantitative, in any degree, but merely reflect, qualitatively, that some reduction has occurred.

LT. J. E. HOWELL

LT. M. MALLORY, JR.

LT. G. C. CARTER

Enc. (4)

[redacted]

1600 9 October 1946
USS ROCKBRIDGE (APA228)

Before Treatment

8'

	.028	.055	.018	.012	.018
	HC1 Brushed on		Citrate and Starch brushed on		
.024	0.06		.028		
	.045	.06	.038	.034	

1600 9 October 1946

8'

.021	.055	.020	.010	
HC1 Brushed on		Citrate and Starch brushed on		
.024				
.28		.012		
Washed salt water pressure		Washed salt water pressure		
.018	.056	.015	.015	

1000 11 October

Before Washdown

	.015	.04	.009	0	
.03	.03		.03		.03
	.025	.045	.008	.01	

After Washdown

	.01	.025	0	0	
.03	.01	.01	0	0	.03
	.009		.009	.009	

READINGS IN r/day

[redacted]

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

MEMORANDUM

Subject: Report on Experimental Decontamination Work on the Salt Water Lines - USS ROCKBRIDGE (APA228)

Reference: (a) Estimate of Total Radioactive Matter on the USS ROCKBRIDGE - Information for

Enclosures: (A) Monitor's Report of Readings before and after Decontamination - USS ROCKBRIDGE.
(B) Procedure used in Decontaminating Salt Water System of the USS ROCKBRIDGE.

1. In the decontamination of salt water lines on the USS ROCKBRIDGE, the following steps were completed as follows:

(a) The system was completely monitored. In order to obtain inside readings and samples, several valves were dropped. Readings are given in Enclosure (A).

(b) Samples were removed from all points in the system which had been opened up. Measurements were made on the quantity of foreign matter at each point, so that an estimate could be made of the total amount of foreign material in the entire system. Samples and data were forwarded to Dr. Scott at the University of California. Details insofar as can be determined by the Shipyard are listed in reference (a).

(c) The fire and flushing system was decontaminated. Samples of decontaminating liquids were delivered to the University of California. Details and procedure are given in Enclosure (B).

(d) The system was resurveyed. The University of California is calculating the total amount of contamination present before and after decontamination and will forward their report separately.

Enc. (5)

[redacted]

(ENCLOSURE (A))

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

Code No: (335)

15 October 1946

MEMORANDUM

Subject: Monitor's Report of Readings before and after Decontamination of Salt Water Mains - USS ROCKBRIDGE (APA228)

1. This report lists the results of the acid treatment in removing radioactivity from the salt water system of the USS ROCKBRIDGE. All readings were taken with the 263 G-M Counter. The external readings (outside of pipes, etc.) are measurements of gamma radiation only. The internal readings were taken with the tube in direct proximity to the active material so that it was exposed to the effect of beta radiation. It is well to note that the beta-gamma readings have no significance as far as the roentgen unit is concerned, but serve merely as a method of comparing the activity of an area in question before and after treatment.

2. The external or gamma readings are difficult to interpret since they are measured on the very lowest part of the scale. This makes any decrease virtually impossible to measure accurately. That the overall activity has been reduced is definite, but in what proportion cannot be said from these readings alone.

3. In the case of the internal or beta readings, we have in most instances a marked drop. Where these readings have been reduced to the level of 0.01 and below we can say that all significant activity has been removed. But, we definitely cannot say that any proportionality exists between total activity before and after and the roentgen figures before and after.

4. It is the judgment of this monitor that in unbroken stretches of piping where good circulation of the acid occurred, 80% to 90% reduction in activity has been effected. In other sections of the system

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where circulation was slow or non-existant, there is a lesser degree of effectiveness of decontamination.

5. All of the following readings are in roentgens per day. "Pb" is the symbol for "plug background" and "b" is the symbol for any "background" reading.

ITEM	Before Decontamination	After Decontamination
Strainer No. 1 F and F Pump	.110 beta	Pb
Strainer No. 2 F and F Pump	.140 beta	Pb
F and F Pump No. 1 water ends	.007 gamma	Pb
F and F Pump No. 2 water ends	.005 gamma	.002 gamma
F and F Pump (open line from)	.120 beta	.003
All discharge valves from F and F Pumps	.007 gamma	Pb
Flush lines to C-101-7L head	.006 gamma	.002 gamma
Flush box to C-101-7L head (inboard)	.007 gamma	.004 gamma
Flush box to C-101-7L head (outboard)	.008 gamma	.005 gamma
Head C-101-10L		
Flush box fwd.	.006 gamma	.002 gamma
Flush box inboard	.006 gamma	.002 gamma
All flush lines	.005 gamma	.002 gamma
Head B-202-A1	.004 gamma	.002 gamma
Flush box		
Head A-204-6	.004 gamma	.004 gamma
Fwd. Head stbd.		
Fwd. Head Port	.004 gamma	b gamma
Laundry	b	b
Fire Plugs (90%)	b	b

$\bar{x}$ = .016 319 $\bar{X}$ = 20

[redacted] Enc. (5) (ENCLOSURE (A))

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(ENCLOSURE (A)) - Continued

ITEM	Before Decontamination	After Decontamination
Fire Mains (General)		
2-37-1 (not lagged)	.030 gamma	.008 gamma
2-47-2 (lagged)	5 gamma	pb gamma
2-75-1 (lagged)	2b gamma	pb gamma
2-82-2	4 gamma	Pb gamma
2-78-1	4 gamma	Pb gamma
2-111-2	b gamma	b gamma
2-121-1	b gamma	b gamma
Magazine sprinkling lines	b gamma	b gamma

$\bar{X}$ = .004/mr 8 $\bar{x}$ = 1.6 R 8

ITEM	External (gamma) Before	External (gamma) After	Internal (beta plus gamma) Before	Internal (beta plus gamma) After
Sea suction strainer assembly #1	.009	Pb	.210	Pb
Sea suction strainer assembly #2	.009	Pb	.380	Pb
Cross-connection No. 1 and No. 2 F and F pumps	.007	b	.340	Pb
Connection to refrigeration cooling	.003	b	.190	Pb
Pump discharge valve 5-92-4	.007	b	.400	Pb
Pump discharge valve 5-91-6	.006	b	.190	.03
Pump discharge valve 5-92-6	.005	b	.240	.001
Sanitary system reducer 2-97-1	.005	.043	.029	.2
(the above due to non-circulation at this point)				
Sanitary system reducer 2-97-3	.007	.003	.290	
Sanitary system reducer 2-63	.014	.006	.290	.05
Cut-off to 2-63 (inlet)	.009	.004	.240	.015
Cut-off to 2-63 (outlet)	.009	.004	.290	.015

12 $\bar{x}$ .008

Enc. (5)

[redacted] (ENCLOSURE (A))

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

Code No. (335)

15 October 1946

MEMORANDUM

Subject: Procedure used in Decontaminating Salt Water System of the USS ROCKBRIDGE - Report on

1. The following decontamination setup was made: A 500 gallon mixing tank was placed topside by No. 4 hatch. A reciprocating air pump was connected to take suction on the acid mixing tank, and hoses led from the pump to discharge into the strainers for both No. 1 and No. 2 fire and flushing pumps. A recirculating hose was run from a bow fire plug back to the acid mixing tank, and another hose from a stern fire plug to the acid mixing tank. The valve from the fire main to the refrigerator cooling system was scoured, inasmuch as the refrigeration condensers contained many dissimilar metals, and it was felt inadvisable to use the muriatic acid in such a system.

2. The following procedure was followed:

(a) At 0720 the unhibited muriatic acid solution at 1 normal was started into the system. The ship's crew worked forward and aft from the fire and flushing pumps, opening up each outlet until flow of acid started. It was necessary in this procedure to provide men working on outlets in compartments with breathing apparatus to prevent their being overcome by acid fumes.

The system was apparently full at 1030, and acid recirculation was commenced. As air pockets were purged in the various lines, it was found necessary to add more acid solution. 750 gallons were needed in this final filling, making a total of 3100 gallons to fill the complete fire and flushing system. Monitor readings taken throughout the recirculation process indicated "floating" readings throughout at about 1300.

Enc. (5) (ENCLOSURE (B))

(ENCLOSURE (B)) - Continued

(b) Titrations in the recirculating tank showed the following:

Initial solution	0.92 Normal
After 3/4 hrs. circulation	0.55 Normal
After 2-1/2 hrs. circulation	0.48 Normal

(c) During the acid circulation samples from three (3) fireplugs not in line with the direct recirculation flow were tapped for samples:

Aft fire plug	0.1 Normal
Midships fire plug	0.0 Normal
Fwd. fire plug	0.2 Normal

All fire plugs were therefore tapped and about two gallons removed to insure replacement of spent acid with fresh. It would appear advisable to move the recirculating hoses around to several outlets to avoid stagnant spots as found above.

(d) At 1400 the ship's crew began draining acid from the lines. Again rescue breathing apparatus was necessary for those working below decks. Complete drainage was effected in 3-1/2 hours.

(e) At 1745 the ship commenced filling the salt water system with fresh water, running the first flow from various outlets into the acid collecting tank, after which the outlets were flushed into the bottom of the drydock.

(f) At 1900 the process of draining water from the mains was started. A neutralizer solution (three ounces per gallon solution of trisodium phosphate) was introduced at 2145, taking a total of two hours to fill the system. The neutralizer solution was let stand overnight.

UNCLASSIFIED

Code 180

4 Nov. 1946

C-S(99) - (1)(180)
C-EN16/A2-11
Serial: 01661

[redacted]

To: Commander, Western Sea Frontier, Federal Office Building, San Francisco, California.
Commander, San Francisco Naval Shipyard, San Francisco 24, California.
University of California, Berkeley, California
Attn: Dr. J. G. Hamilton.

Subj: Radiological Decontamination Program - Development of.

Ref: (a) CNO Conf. Ltr. OP-602/cmf, Serial: 021P602(SC), S67-1 of 27 August 1946.

1. Reference (a) assigns to the Bureau of Ships, among other items, responsibility for developing methods and equipment for decontamination of ships of the Navy. The Bureau of Medicine and Surgery is assigned cognizance and responsibility for establishing safety tolerances and regulations in the radiological safety program for the Navy.

2. The most pressing radiological problem facing the Navy at present is the decontamination of the CROSSROADS non-target ships. the following statement of Bureau of Ships policy in connection with the handling of decontamination of these ships is promulgated for the information and guidance of the addressees.

(a) The Bureau of Ships will coordinate the efforts of all activities in the investigation and development of ship decontamination procedures, will promulgate to cognizant activities approved methods, and will furnish technical assistance as required in the development and accomplishment of the approved processes.

[redacted]

UNCLASSIFIED

1[illegible] October 1946

Subject: Decontamination of Evaporator Unit on USS WALKE (DD723)

1. The procedure for decontaminating the evaporator (two effect, Griscolm - Russell) solo shell) on the USS WALKE is as follows:

   a. Inhibited muriatic acid of initial concentration 1.24 normal was added until the evaporator unit was completely filled. This required a total of 950 gallons. After the filling was completed, the acid was recirculated by taking suction on the acid mixing tank with the circulating pump and discharging from the brine pump into the acid tank. After two hours of circulation the normality was checked at 0.64 and it was decided to stop acid circulation and carry on the following steps:

      (1) Pump all acid into the disposal tank

      (2) Flush with fresh water.

      (3) Circulate neutralizer solution for 30 minutes

      (two ounces of soda ash per gallon of water)

      (4) Drain completely.

      (5) Flush with fresh water for several hours.

2. The monitor readings follow:

Enc. (6)

	Before	After
Inside first effect	0.10 beta 0.007 gamma	0.002 beta bkg.
Inside second effect	0.05 beta 0.002 gamma	0.001 beta 0.001 gamma
Air ejector cond.	0.003 gamma	bkg.
Cond. Cooler	0.007 gamma	bkg.
Feed Lines	-	0.001 gamma
Brine lines	-	0.001 gamma.

Enc. (6)

UNCLASSIFIED

16 October 1946

Subject: Report on Decontamination of Evaporators - U.S.S. ROCKBRIDGE.

1. This decontamination was conducted on the same plan as other work on the U.S.S. ROCKBRIDGE - namely to obtain information for study by the University of California.

(a) Complete monitoring
(b) Quantitative sampling
(c) Decontamination
(d) Resurvey

2. Information on procedure and monitoring is given below. Results of the quantitative studies of Dr. Scott will be forwarded by him.

A - Procedure

An acid mixing tank was set up topside. From this an air pump took suction and discharged to the inlet side of the condensate cooler of each set. This plant consisted of two sets of double effect Foster Wheeler (20,000 gal/day) evaporators. Each set required 1500 gallons of acid solution for filling. When the acid filling of each set was complete the filling hose was disconnected and a jumper line was connected from the discharge side of the brine pump to the suction side of the circulating pump. Both pumps were run for rapid circulation.

The acid solution consisted of two parts commercial hydrochloric acid to fifteen parts water plus 0.02 parts of Specification 51-I-2 inhibitor. Acid circulation was carried on for four hours and fifteen minutes in the case of Evaporator No. 1 and three hours and forty minutes in the case of Evaporator No. 2.

Enc. (7)

UNCLASSIFIED

Only one reading was taken on Number 1 Evaporator, and after 2-1/4 hours circulation, the solution was found to test 1.25 normal.

Evaporator number 2 was tested as follows:

Initial solution	1.4N
After 1-1/4 hours circulation	0.91N First effect
	1.12N Second effect
After 3-1/4 hours circulation	0.90N First effect
	0.96N Second effect

After acid circulation the following steps were completed

(1) Acid pumped into disposal container
(2) Evaps flushed with fresh water
(3) Circulation of neutralizer solution carried on for 30 minutes (two ounces per gallon of soda ash in fresh water)
(4) Final complete flushing with fresh water

B - Monitor's Survey of Decontamination of Evaporators - U.S.S. ROCKBRIDGE

pb = plus background
b = background

	before	after
#1 Evaporator unit		
First effect shell	.007 gamma	pb
Feed heater	.009 "	b
Inspection plate (sump)	.005 "	pb
Second effect shell	.005 "	pb
Inspection plate (sump)	.003 "	pb
Distiller cond. shell	.080 "	pb
" " head	.030 "	.030
Cond. cooler	.050 "	pb
Feed line	.029 "	pb
First effect inside sump	.190 beta	pb
Second effect inside sump	.050 beta	pb

[redacted]

#2 Evaporator unit	before	after
First effect shell	.009 gamma	b
Sump plate	.006 "	b
Feed heater	.009 "	b
Second effect shell	.005 "	b
Sump plate	.003 "	b
Dist. condenser	.050 "	*
Brine overboard	.006 "	pb
Cond. cooler	.060 "	pb
Feed line	.030 "	pb
First effect inside sump	.260 beta	pb
Second effect inside sump	.60 beta	.005
Back pres. valve, brine overboard	.000 gamma	.015

* .003 gamma except one spot off scale. This will be opened for examination.

[redacted]

16 October 1946

Subject: Report on Experimental Decontamination of Auxiliary Condenser on the U.S.S. BOTTINEAU

1. It was decided to conduct a test of decontamination on an auxiliary condenser using the boiler compound boiling out procedure specified normally for the fresh water sides on the U.S.S. BOTTINEAU. Connections were made to the salt water side of No. 1 auxiliary condenser for filling with a solution of fresh water and boiler compound in the proportions 1 lb. boiler compound to 10 gallons of fresh water. Steam connections were made. Boiling out was carried on for a period of 12 hours, after which the system was thoroughly flushed out with water. In the boiler compound solution removed from the condenser no activity was found, although the solution had apparently removed a considerable amount of sludge. Both heads of the condenser were dropped for inspection, and it was found that most of the scale and rust, particularly on the iron heads, was still there. Monitoring inspection of the condenser after decontamination showed that the process had accomplished very little. Monitor readings for this experiment are given below. Zincs had been removed before the first readings.

	before	after
Through shell	.072 gamma	.078 gamma
Injection line	.014 "	.014 "
Overboard line	.010 "	.010 "
Against tubes	.190 "	.144 "
	.48 beta	.384 beta

Most of the fouling which was present in the condenser before the process was in the form of hardened scale and rust which apparently was not chemically affected by the boiler compound and which was not mechanically loosened by the very slow circulation effected in the process of decontamination. While the condenser was open the tube sheets were inspected and appeared to be in good condition. For this reason a muriatic acid cleaning is believed adaptable for this type condenser.

Enc. (8)

[redacted]

1', October 1945

Subject: Decontamination of Condensers - U.S.S. WALKE

1. Before designation of a decontamination method for condensers had been promulgated, the engineering personnel of the U.S.S. WALKE conducted a mechanical decontamination. This consisted of removing old zincs, cleaning foreign matter from the tubes by punching out, and then pressure washing the tubes and circulating lines. The monitor readings which follow indicate the effectiveness of this process:

	Before	After
#1 Main Condenser		
inside injection line	0.017 beta	.002
against tubes	0.025 beta	.001
#2 Main Condenser		
inside injection line	0.048 beta	0.012
against tubes	0.02 beta	0.005
#1 Aux. Condenser		
inside injection header	0.22 beta	0.065

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UNCLASSIFIED

Code 180

4 Nov. 1946

C-S(99) - (1)(180)
C-EN18/A2-11
Serial: 01661

[redacted]

To: Commander, Western Sea Frontier, Federal Office Building, San Francisco, California.
Commander, San Francisco Naval Shipyard, San Francisco 24, California.
University of California, Berkeley, California
Attn: Dr. J. G. Hamilton.

Subj: Radiological Decontamination Program - Development of.

Ref: (a) CNO Conf. Ltr. OP-602/cmf, Serial: 021P602(SC), S67-1 of 27 August 1946.

1. Reference (a) assigns to the Bureau of Ships, among other items, responsibility for developing methods and equipment for decontamination of ships of the Navy. The Bureau of Medicine and Surgery is assigned cognizance and responsibility for establishing safety tolerances and regulations in the radiological safety program for the Navy.

2. The most pressing radiological problem facing the Navy at present is the decontamination of the CROSSROADS non-target ships. the following statement of Bureau of Ships policy in connection with the handling of decontamination of these ships is promulgated for the information and guidance of the addressees.

(a) The Bureau of Ships will coordinate the efforts of all activities in the investigation and development of ship decontamination procedures, will promulgate to cognizant activities approved methods, and will furnish technical assistance as required in the development and accomplishment of the approved processes.

[redacted]

UNCLASSIFIED

C-S(99)-(1)(180)
C-EN28/A2-11
Serial: 01661

[redacted]

(b) The ship decontamination measures approved and promulgated by the Bureau of Ships will be designed to reduce quantities of radioactive materials and radiation levels to standards prescribed by the Bureau of Medicine and Surgery for complete and unrestricted radiological clearance. All approved decontamination methods will include strict observance of radiological safety precautions considered necessary by the Bureau of Medicine and Surgery.

(c) By arrangement with the Manhattan District the services of the University of California laboratory group are available to the Navy for assistance in developing techniques, materials and procedures by laboratory investigation for removal of radioactive materials from contaminated portions of ships. The University will also make qualitative and quantitative analysis of contaminating material on ships under investigation and will submit information so obtained to the Bureau of Medicine and Surgery and the Bureau of Ships through their authorized West Coast representative, if available, to assist in establishing safe radiation limits for clearance and portions of ships requiring decontamination. All recommendations as to decontamination techniques together with supporting data will be forwarded to the Bureau of Ships for approval, through its West Coast representatives, if available, otherwise to the Bureau directly.

(d) Naval Shipyard San Francisco will expand the laboratory procedures developed by the University of California and from the data obtained will work out suitable practical methods for application to ships. Personnel and equipment to augment the facilities of Naval Shipyard San Francisco to expand the radiological decontamination development work are under consideration. The Shipyard will maintain close liaison through a designated representative and work in conjunction with the University of California supplying information and appropriate samples of material to enable the university laboratory to conduct its research and analysis work effectively. Procedures for

[redacted]

C-S(99)-(1)(180)
C-EN28/A2-11
Serial: 01661
[redacted]

removal of radioactive materials from ships as developed by Naval Shipyard San Francisco will be submitted to the Bureau of Ships for approval prior to general application to vessels.

3. The policies outlined above are concurred in by Manhattan District and the Bureau of Medicine and Surgery.

C. D. Wheelock, Rear Admiral, USN
Deputy and Ass't Chief of Bureau

CC:
CNO
CinCPac
BuMed
ComGenManhattan
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SAN FRANCISCO NAVAL SHIPYARD

SAN FRANCISCO 24, CALIFORNIA.

[redacted]

14 November 1946

MEMORANDUM

Subject: Decontamination of Auxiliary Condensers.

1. The following observations are summarized:

(a) In auxiliary condenser systems copper nickel throughout. For auxiliary condenser systems composed of copper nickel pipe, copper nickel heads, tubes and tube sheets, the use of 1/2 normal muriatic acid circulated for a period of one hour has proved sufficient to accomplish decontamination. This has been evidenced both in cases in which the condensers had previously been boiled out with boiler compound and in condensers having no previous treatment.

(b) In condenser systems composed of the combination of ferrous and non-ferrous, as in the typical Maritime Service ships:

(1) Circulation of 1/4 normal acid for a period of one hour has accomplished no results.

(2) Boiling out with boiler compound has accomplished no results.

(3) Circulation with 1/2 normal acid for a period of one hour has accomplished only 25% reduction in radioactivity.

(4) Manual cleaning consisting of tube punching and scraping of heads followed by thorough flushing out with acid has accomplished sufficient decontamination. However, this

[redacted]

[redacted]

does not necessarily decontaminate pipe systems leading to and from the condensers. These would have to be decontaminated separately using one normal acid for any salt water system.

(5) The method appearing to be the most thorough is as follows:

a. Remove heads and scrape as much rust off as possible from the heads.
b. Reassemble.
c. Hook up the acid circulation in such a manner that the auxiliary condenser circulating pump can be run taking suction on sea water so as to provide thorough flushing. In general, thermometer and pipe lead off connections are available for acid connection.
d. Run one-half normal muriatic acid through the condenser for a period of one hour.
e. Drain, start circulating pump and thoroughly flush for several minutes.
f. Monitor the injection in overboard lines:

-1- If lines are above tolerance repeat above acid cleaning.

-2- Continue procedure until overboard and injection lines are within tolerance limits.

-3- Then check the condenser itself and accomplish any remaining decontamination necessary by manual cleaning. If necessary, the heads may have to be removed and filled with acid until heads are below tolerance.

[redacted]

LABORATORY REPORTS

OF

EXPERIMENTAL WORK

SAN FRANCISCO NAVAL SHIPYARD

File (380)

San Francisco 24, California

26 September 1946

MEMORANDUM LABORATORY TEST REPORT - PRELIMINARY

Subj: De-Contamination

1. 50 gallons of 1 Normal solution of Hydrochloric Acid, uninhibited, was circulated through a section of iron fire main aboard the USS HENRICO (APA45). Upon completion of the cleaning operation it was desired to estimate the quantity of rust and scale removed. A sample of the final solution was tested and found to contain 1.02% of ferrous oxide and 1.14% of calcium carbonate. These percentages indicate 4.8 pounds of calcium carbonate and 4.3 pounds of iron oxide were removed from the section of pipe. In addition to the salts dissolved in the solution it is estimated that approximately one pound of iron oxide was also present as a sludge.

JOHN E. HOWELL
Asst. Shop Supt for Laboratory

GEORGE M GORDON
Yard Chemist

CC: 300
350
335
335 (for Captain Maxwell)
857

[redacted]

SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, California

File (380)

MEMORANDUM LABORATORY TEST REPORT, PRELIMINARY

26 September 1946

Subject: De-Contamination

1. One section of copper-nickel pipe from the USS LAFFEY (DD724) and a section of steel pipe from the USS BOTTINEAU (APA235) salt water systems were selected and cut into test specimens. Radioactivity readings were made and the samples immersed in the following solutions: 1/2, 3/4 and 1 Normal uninhibited Hydrochloric Acid, and 1/2 and 2 times strength Ammonium Citrate buffer solution. Radioactivity readings of the solution were made over a period of time and the increase in radioactivity is shown in Figure 1.

2. Single strength buffer solution is prepared by mixing 24 pounds of Citric Acid and 17 pounds of 28% Ammonium Hydroxide and diluting to 50 gallons with water. The pH is adjusted to 6.0. A double strength buffer solution is the same weight of chemicals diluted to 25 gallons with water.

3. The readings are relative, as time requirements made it impossible to attempt to convert them to an absolute basis. There was no time, for example, to evaporate samples to dryness to correct for mass. The data show increase in radioactivity in the solution with time.

4. It can be assumed that when the activity in solution ceases to increase, the optimum time of contact with the given solution has been reached. This optimum time, found under laboratory conditions, is taken to be the least time of contact for that solution to give effective results. It should be pointed out, however, that circulation of the solution in contact with radioactive material in practice could be expected to cut down this optimum time, as determined in a still solution in the laboratory.

GEORGE M. GORDON
Yard Chemist

JOHN E. HOWELL
Asst. Shop Supt. - Lab.

CC: 300
350
335
385 (for Captain Maxwell)
857

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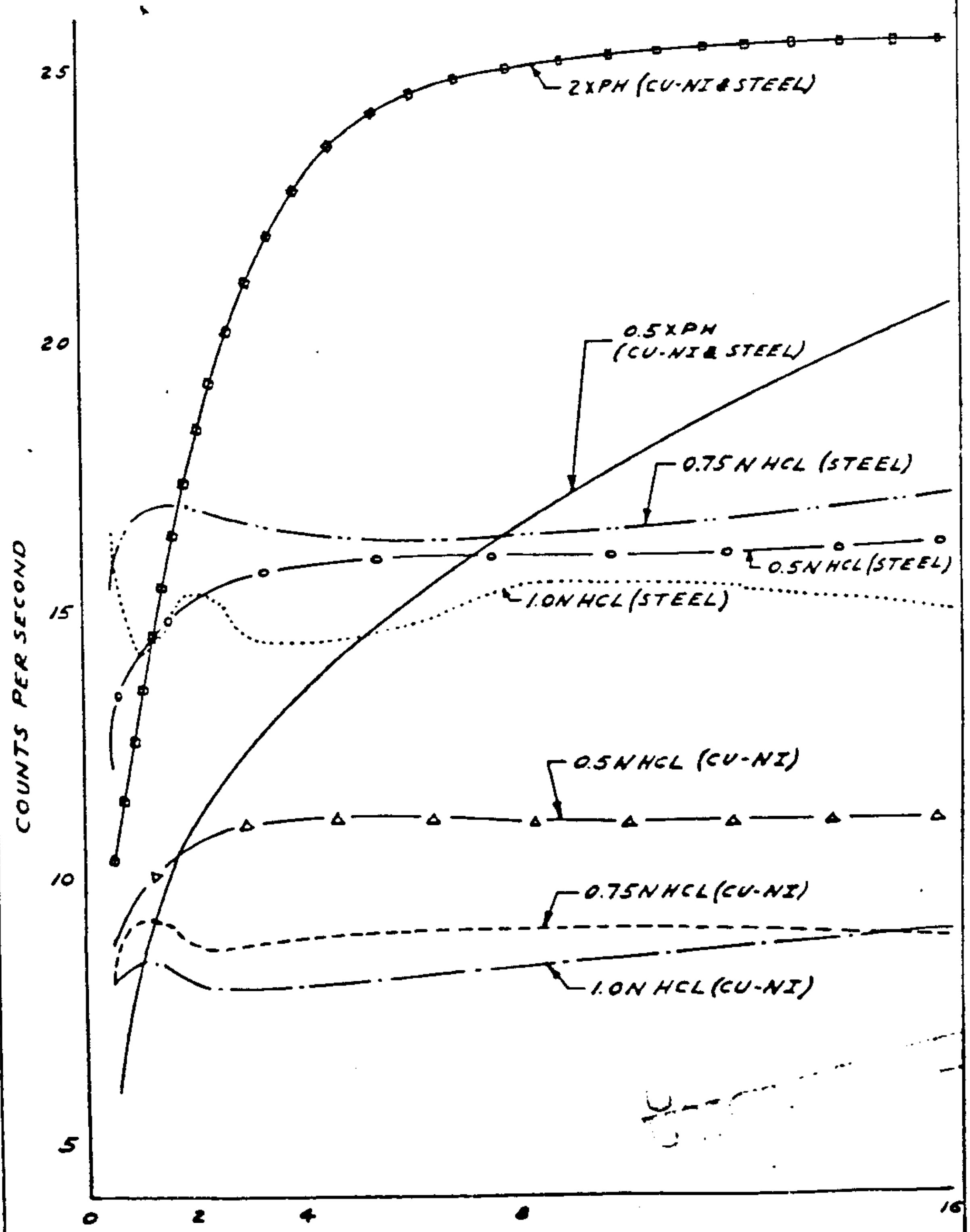

2XPH (CU-NI & STEEL)
0.5XPH (CU-NI & STEEL)
0.75N HCL (STEEL)
0.5N HCL (STEEL)
1.0N HCL (STEEL)
0.5N HCL (CU-NI)
0.75N HCL (CU-NI)
1.0N HCL (CU-NI)
COUNTS PER SECOND
25
20
15
10
5
0
2
4
8
16
TIME IN HOURS

FIGURE I

File (330) SAN FRANCISCO NAVAL SHIPYARD

San Francisco 24, Calif.

[redacted]

26 September 1946

MEMORANDUM LABORATORY TEST REPORT (Preliminary)

Subject: De-Contamination

1. Two ten foot sections of fire main, one copper-nickel from the USS LAFFEY and one iron from the USS BOTTINEAU (APA235) were fitted with flanges on both ends and connected on one end so as to permit steam, water or air to pass through the pipe. Radioactivity measurements were made at various locations along the length of the pipes.

2. Steam was passed through the pipe until the surface temperature on the outside was approximately 180°F as measured with a Surface Pyrometer. When this temperature was obtained the steam was secured and cold water (60°F) was immediately forced through the pipe until the surface temperature dropped to 60°F (the time required for heating or cooling the pipe was in the order of 30 seconds.) Air was then blown through the pipe to remove the water, and the flanges were removed and radioactivity readings again taken.

3. The entire process was then repeated as in the above paragraph. Results of readings by the monitors are as follows, in roentgens for 24 hours:

[redacted]

Iron Pipe

Test location	Initial Reading	1st shock	2nd shock
inlet	0.4		0.08
1 ft from inlet	0.008	0.002	0.002
2 ft from inlet	0.07	0.003	0.002
3 ft from inlet	0.05	0.003	0.002
4 ft from inlet	0.07	0.005	0.002
5 ft from inlet	0.07	0.003	0.002
6 ft from inlet	0.05	0.003	0.002
7 ft from inlet	0.05	0.003	0.002
8 ft from inlet	0.05	0.003	0.002
Discharge	0.5 +	0.01	0.01
Pipe temp		150°F	210°F

B G equals Background Rating

Copper Nickel Pipe

Test location inlet	Initial Reading	1st cycle	2nd cycle
3'from inlet	0.007	0.002	B G
4-1/2' " "	0.009	----	B G
5-1/2' " "	0.012	0.002	B G
7' " "	0.014	0.003	0.003
8' " "	0.012	0.003	B G
9' " "	0.008	0.003	B G
10' " "	0.007	0.003	B G
Discharge	0.20	0.04	0.03
Pipe temp		190°F	210°F

4. All radioactivity readings were taken with a Type X-263 portable instrument. The original copper-nickel pipe contained a large quantity of marine growth, whereas the steel pipe contained only rust and scale approximately 1/8" thick, all the marine growth was removed from the copper-nickel pipe with the exception of a small patch (approximately 2-1/2" by 5") located 7 feet from the inlet end of the pipe. At the completion of the test the pipe was cut so as to better reveal the remaining marine growth. The radioactivity measurement of this growth was 0.08. One other cut was made through the clean section of this pipe, its radioactivity reading was 0.007. Photographs were taken during and after the tests and will be forwarded under separate cover.

GEORGE M GORDON
Yard Chemist

JOHN E. HOWELL
Asst. Shop Supt. for Laboratory

CC: 300
350
335
335 (for Captain Maxwell)
857

[redacted]

File (380) SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, Calif.

26 September 1946

MEMORANDUM LABORATORY TEST REPORT, PRELIMINARY

Subj: De-Contamination

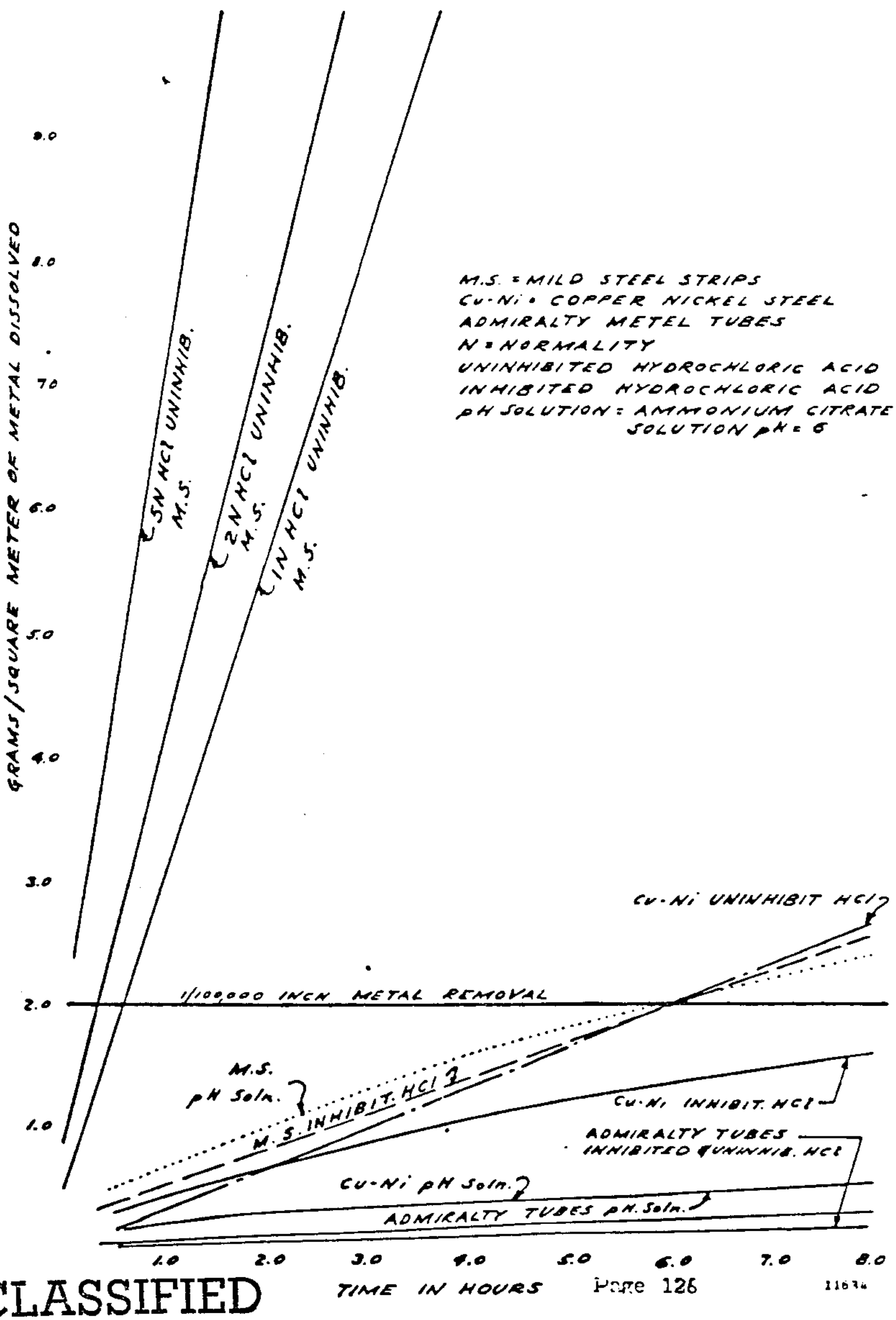
1. A series of tests were conducted to determine the attack of various solutions on metals normally present in salt water systems. The test specimens used were 1/2" x 3" x 1/16" copper-nickel and mild steel strips, and 3" sections of admiralty metal evaporator tubes.

2. The solutions used were (a) 1, 2, and 5 Normal uninhibited Hydrochloric Acid, (b) 1, 2, and 5 Normal inhibited Hydrochloric Acid, and (c) 1/2, 1, 2 and 4 times strength Ammonium Citrate buffer solution. The specimens were completely immersed in the solutions without agitation and at room temperature. They were removed and weighed at the intervals shown on the accompanying graph.

3. Single strength buffer solution is prepared by mixing 24 pounds of Citric Acid and 17 pounds of 26% Ammonium Hydroxide and diluting to 50 gallons with water. The pH is adjusted to 6.0. A double strength buffer solution in this same weight of chemicals diluted to 25 gallons with water.

GEORGE M. GORDON
Yard Chemist

JOHN E. HOWELL
Asst. Shop Supt. - Laboratory


GRAMS/SQUARE METER OF METAL DISSOLVED
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
M.S. = MILD STEEL STRIPS
Cu-Ni = COPPER NICKEL STEEL
ADMIRALTY METEL TUBES
N = NORMALITY
UNINHIBITED HYDROCHLORIC ACID
INHIBITED HYDROCHLORIC ACID
pH SOLUTION = AMMONIUM CITRATE SOLUTION pH = 6
5N HCl UNINHIB. M.S.
2N HCl UNINHIB. M.S.
1N HCl UNINHIB. M.S.
Cu-Ni UNINHIBIT HCl
1/100,000 INCH METAL REMOVAL
M.S. pH Soln.
M.S. INHIBIT. HCl
Cu-Ni INHIBIT. HCl
ADMIRALTY TUBES INHIBITED & UNINHIB. HCl
Cu-Ni pH Soln.
ADMIRALTY TUBES pH. Soln.
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
TIME IN HOURS

SAN FRANCISCO NAVAL
SHIPYARD
SAN FRANCISCO 24, CALIFORNIA

C O P Y

26 September 1946

[redacted]

MEMORANDUM LABORATORY TEST REPORT (Preliminary)

Subj: Report on De-Contamination of Valves.

1. Ten valves of various sizes were processed in Ammonium Citrate buffer solution to determine the rate of radioactivity removal by this solution.

2. The valves were obtained from the salt water system of the USS LAFFEY (DD724), the tests were conducted on the fantail of the ship. The solution was prepared by mixing 192 pounds of commercial grade Citric Acid and 136 pounds of 28% commerical Ammonium Hydroxide and diluting to 100 gallons. The pH of the solution was adjusted to 6.0. Radioactivity readings were taken by Monitors using a Type X-263 portable instrument. The valves were then immersed in solution for the intervals listed below. At the designated intervals they were removed and radioactivity readings again made by the Monitor. After each reading they were replaced in the solution until time for the next reading. The valves were not rinsed prior to the taking of the readings.

3. Results of the readings on the ten valves are as follows:

TOTAL HOURS	VALVE NUMBER									
	1	2	3	4	5	6	7	8	9	10
0	0.01	0.21	0.008	0.28	0.29	0.29	0.15	0.01	0.36	0.045
1	0.002	0.005	0.008	0.017	0.005	0.009	0.009	0.002	0.007	0.005
2	0.002	0.005	0.005	0.012	0.002	0.007	0.007	0.002	0.005	0.005
4	0.002	0.002	0.005	0.007	0.002	0.007	0.007	0.002	0.005	0.005
8	0.002	0.002	0.005	0.005	0.002	0.005	0.005	0.002	0.002	0.004
16	0.002	0.002	0.003	0.005	0.002	0.005	0.005	0.002	0.002	0.004

[redacted]

Readings are Roentgen units in 24 hours.

4. Photographs of the tests will be forwarded under separate cover.

GEORGE M GORDON
Yard Chemist

JOHN E. HOWELL
Asst. Shop Supt. for Laboratory

CC: 300
350
335
335 (for Captain Maxwell)
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SAN FRANCISCO NAVAL SHIPYARD
San Francisco 24, California

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26 September 1946

DECONTAMINATION OF RADIOACTIVITY
FROM SALT WATER PIPING

Purpose: To effect procedures to successfully decontaminate radioactivity from salt water piping of vessels present at Bikini - Test Baker.

Procedure:

(a) Use of pH6 solution (Citric Acid and Ammonium Hydroxide).

On 14 September 1946 at 1100, a section of firemain on the USS LAFFEY was pumped full of pH6 solution (Citric Acid and Ammonium Hydroxide) and was allowed to stand for 72 hours until 17 September 1946 at 1100, at which time it was blown out.

An air hose was attached to one end of the firemain and a hose led from the other end to a steel barrel on the main deck, and the firemain was blown clear.

The barrel of solution showed radioactivity (.010) and was taken to the Industrial Laboratory for arrangements for disposal.

After the firemain was blown clear of the solution, the air service was disconnected and a fresh water main connected to the firemain. The hose at the outlet was led to a second barrel for examination of the first amount of flushing water. This water was found to be practically free of emission, and the discharge hose was led into the Bay. Flushing operations continued overnight.

[redacted]

RESULTS. GIEGER READINGS

OUTSIDE OF PIPE

Before	After	
.02	.007	
.017	.006	Note: Each of these
.012	.005	readings occurred in
.008	.003	several places along
(Background	002)	the pipe.

INSIDE OF PIPE

Before		After	
.05	.5	.008	.08

The Citric Acid and Ammonium Hydroxide - pH6 solution was effective in removing about 90% of the radioactivity

It was not effective in removing marine growth, a very little barnacle and scale was removed.

(b) Use of Hydrochloric Acid - 1% normal solution.

A 50-ft. section of copper-nickel salt water piping on the USS LAFFEY was blanked off and furnished with hose connections at each end. A reservoir in the form of a 50-gallon steel barrel was set up and filled with a 1.08% normal solution of Hydrochloric Acid. The acid was pulled from the reservoir through a reciprocating air pump to the blanked off section of piping. (This section had been flushed with fresh water for 30 minutes previously.)

Within a matter of minutes after the start of the acid circulating operation, the drum solution began to show radioactive emission.

At the end of eight hours, the acid content had levelled off to about 0.45% normal, and 45 minutes later the acid circulation was stopped.

The section of piping was then blown clear of acid with air, all of the acid being collected in the acid barrel.

One and one-half hours later, flushing operations with fresh water were started. The first barrel of flushing water showed radioactivity and was

[redacted]

saved for disposal at sea. The second barrel was safe and the hose was led overboard to the Bay. Fresh water flushing was continued for one hour and ten minutes.

A second acid circulating phase was begun with an .88 concentration of hydrochloric acid and continued for four hours. Fresh water flushing operations were performed for 45 minutes

RESULTS:

GIEGER READINGS

OUTSIDE OF PIPE

Before	After 1st phase	After 2nd phase
.08	.007)	
.07	.007)	
.05	.007) -	Reduced to Background (.001)
.03	.002)	
.02	.002)	
.01	.002)	
(.036	.029	
(.024	.021	
(.010	.017	

Between flanges, upward slant, dead end.

INSIDE OF PIPE

Before		After 2nd Phase	
.5	.2	.001	.002
.3	.08	.001	.002

98% of radioactivity was removed.
100% of marine growth and scale was removed.

(c) Use of pH6 solution (Citric Acid and Ammonium Hydroxide) on iron pipe.

On 18 September 1946 a section of iron pipe on the flushing system of the USS HENRICO was pumped full of pH6 (citric acid and ammonium hydroxide) and was allowed to stand for 72 hours, after which time it was blown out.

The barrel in which the solution was collected was kept until arrangements could be made for disposal.

Fresh water flushing was continued overnight.

RESULTS:

GEIGER READINGS

OUTSIDE OF PIPE

Before	After
.014	.002
.012	.003
.008	.002 (Background
.005	.002 .002)

INSIDE OF PIPE

Before		After	
.012	.5	.003	.08

Scale was still present in about the same amount as before.

(d) Use of Hydrochloric Acid - 1% normal solution, on iron pipe.

On 18 September 1948 a section of iron pipe on the USS HENRICO was blanked off and furnished with hose connections at each end. A reservoir in the form of 50-gallon steel barrel was set up and filled with a 1% normal solution of hydrochloric acid. The acid was pulled from the reservoir through a reciprocating air pump to the blanked off section of piping.

The acid circulation was started and continued for about eight hours.

The pipe was then flushed with fresh water for about 1 hour.

RESULTS:

GEIGER READINGS

OUTSIDE OF PIPE

Before	After
.02 (	
.017 (	
.012 (	Reduced to
.008 (	Background
.005 (	(.002)
.003 (	

INSIDE OF PIPE

Before		After	
.005	.4	.002	.003
.007	.34	.002	.003

Practically all of the scale was cleared up in the operation except for a little loose scale at one end.

UNCLASSIFIED

(335) SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO 24, CALIFORNIA

[redacted]

30 September 1946

MEMORANDUM TO: THE COMMANDER

Subject: Study of Decontamination of Salt Water Lines Based Upon Experimental Information to Date.

1. This study is made for the purpose of assembling information for examination at a conference of Shipyard, BuShips, BuMed and University of California representatives in order to determine the type and strength of solution that should be recommended to BuShips for use in removing radioactive matter from the salt water systems aboard BIKINI ships.

2. The information contained herein is a summary of facts drawn from the experimental work on decontamination of salt water lines conducted at San Francisco Naval Shipyard. Where pertinent, explanatory notes are included to explain the limitations of the data included.

3. Before a recommendation can be reached on the minimum strength solution and minimum time of use, the following must be resolved to form the basis for decision:

(a) The lower limit of radioactivity that must be reached in decontaminating a salt water system.

(b) The extent that scale and sea growth must be removed in the decontamination process.

(c) The extent to which damage may be allowed to valves, pumps, and piping in the salt water system.

[redacted]

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4. The following experimental work and results therefrom are available to date:

(a) Tests for decontaminating salt water lines by means of flushing with salt water, saturated solution boiler compound and fresh water, saturated solution boiler compound and salt water, have all shown such negative results as to be excluded completely in this study.

(b) Test of thermal shock on radioactive and badly fouled sections of pipe. Each of the pipe sections was provided with an inlet manifold to which was connected steam, cold water, and air. Steam was passed through the pipe until the temperature reached 180°F. The steam was turned off and water turned on simultaneously. As soon as the temperature of the pipe dropped to normal the water was cut off and the pipe blown out by air.

Results follow:

	Before		After
CuNi pipe (10 ft. length)	Outside highest	0.014	0.003
	Inside	0.20	0.06
	Heavy Marine growth throughout		All growth removed except one patch 2"x 5".

	Before		After
Fe pipe (10 ft. length)	Outside highest	0.07	0.003
	Inside greater than	0.5	0.01
	Heavy scale		Scale not appreciably affected.

(c) Tests involving ammonium citrate and muriatic acid solutions:

(1) USS LAFFEY copper nickel lines containing large amounts of marine growth:

Circulation of muriatic acid solution. A 50 ft. test section copper-nickel main was circulated for six (6) hours with an

[redacted]

initial concentration of 1.08 normal solution muriatic acid. Rapid circulation was carried on for 6 hours and 45 minutes, after which the main was blown out and cleared by flushing with fresh water. A second acid circulation phase was an initial concentration of 0.86 normal which was carried on for four (4) hours. The second phase showed little drop in normality of the acid, and it was concluded that the second phase was unnecessary.

RESULTS: All sea growth was removed. Removal of radioactivity matter is summarized as follows:

Muriatic Acid solution 1 Normal	Before	After
Outside of pipe readings	.005 to 0.08	.000 to .007
Inside of pipe readings	(.08 to .2	.000 to .002
	(.3 to over .5	.000 to .002

(2) USS LAFFEY copper nickel lines containing large amounts of marine growth.

A solution of double strength ammonium citrate was introduced into a 50 ft. length of fire main and allowed to stand for 72 hours. This solution was made by mixing 48 lbs. of citrate acid and 34 lbs. of ammonium hydroxide to 50 gallons of water. After removal of ammonium citrate solution, this line was flushed with fresh water.

RESULTS: An estimated 30% of sea growth was removed. Removal of radioactive matter is summarized as follows:

Ammonium Citrate solution pH6.0	Before	After
Outside of pipe readings	.008 to .020	.000 to .007
Inside of pipe readings	.15 and over .5	.008 to .1

(3) USS HENRICO steel lines, containing small amount of sea growth and large amount of scale:

[redacted]

Circulation of muriatic acid solution. Approximately 50 ft. test section of steel flushing main was treated with six (6) hours of muriatic acid circulation (1 normal). Upon completion of acid circulation the line was cleared by flushing with fresh water.

RESULTS: All scale was removed. Removal of radioactive matter is summarized as follows:

Muriatic Acid solution 1 normal	Before	After
Outside of pipe readings	.002 to .02	.000
Inside of pipe readings	.007 and .4	.000 and .008

A sample of the circulated acid solution was remov ed from the pipe in order to estimate the types and quantities of matter removed:

IN SOLUTION - 4.8 lbs. calcium carbonate
4.3 lbs. iron oxide

SLUDGE - 1 lb. iron oxide

(4) USS HENRICO steel lines containing scale and small amount of sea growth.

A solution of double strength ammonium citrate was introduced into the line and allowed to stand for 72 hours, after which it was cleared and the line was flushed with water. This solution was made by mixing 46 lbs. of citrate acid and 34 lbs. of ammonium hydroxide to 50 gallons of water.

RESULTS: The scale inside the pipe was not appreciably affected. Removal of radioactive matter is summarized as follows:

Ammonium Citrate solution pH6.0	Before	After
Outside of pipe readings	.002 to .014	.000 to .003
Inside of pipe readings	.012 and over .5	.000 to .08

[redacted]

(5) USS BENEVOLENCE. On the BENEVOLENCE a 16" steel cross-over line forming the lower suction for the three auxiliary condensers showed such high readings as to prohibit the ship from sailing. These readings ranged from 0.1 to 0.9 gamma. This line was treated as follows:

a. Steam injected into section until the temperature of the line reached 170°F., at which time the main was flooded with cold water (cold shock). RESULTS: Negative.

b. Same as above. The temperature was allowed to reach 195°F.

c. A 2 normal muriatic acid solution was injected into the main and slowly circulated for 1 hour and 40 minutes. The section of line was then flushed with salt water for five minutes, then drained and subsequently flushed with a neutralizing solution containing soda ash. The readings after this treatment ranged from .005 to .070 gamma.

(6) A condensate cooler from the USS BENEVOLENCE was filled with a 1 normal inhibited solution of muriatic acid and let stand for one hour. The reading reduced from 0.25 to 0.03.

(7) Nine valves from the USS BENEVOLENCE evaporator brine and overboard lines were treated by dipping and scrubbing in a twice normal inhibited solution of muriatic acid. Time to reduce readings to background varied from 10 to 30 minutes, the time appearing to be a function of the Geiger readings.

Readings before:	0.012
Readings after:	0.006

No visual signs of attack on the valve and valve seat metal could be noted.

Those results could have been bettered by dismantling all valves. Those dismantled showed final readings at 0.000.

[redacted]

It should be noted here that the valves contained radioactive matter in the upper portion of the bonnet. Such surfaces require longer than the short period of this test for complete decontamination because the flushing action following the acid treatment does not reach into the recesses to wash out the loosened foreign matter. Conclusions from tests on straight runs of pipe to determine the minimum time for decontamination must be modified to allow additional time for more complete acid reactions in the recesses when the piping system is considered as a whole.

(8) Tests were conducted on ten CuNi valves in a solution of ammonium citrate with pH 6.0 but with twice the strength of the original test solution on the USS LAFFEY. The present test solution was in the proportions: 24 lbs. Citric Acid; 17 lbs. Ammonium Hydroxide; 12.5 gals. water, and is designated as 4 strength.

VALVE NUMBERS - all readings are Beta

Hours Immersed	1	2	3	4	5	6	7	8	9	10
0	0.010	0.210	0.008	0.230	0.290	0.290	0.150	0.010	0.290	0.045
1	.002	.005	.006	.017	.005	.005	.009	.002	.007	.005
2	.002	.005	.005	.012	.002	.005	.007	.002	.005	.005
4	.002	.002	.005	.007	.002	.005	.007	.002	.005	.005
8	.002	.002	.005	.005	.002	.0012	.005	.002	.005	.005

Here again, complex assemblies take longer than is indicated by laboratory tests on simple formed samples. Most removal of radioactive matter is accomplished in one (1) hours. However, in this 4 strength ammonium citrate four (4) hours were necessary before every valve showed reading below 0.01 Beta.

(9) Test samples of copper nickel and steel pipe were treated in the Laboratory with various strength solutions of hydrochloric acid and ammonium citrate. The copper nickel pipe was fouled with sea growth approximately 50% by volume. The steel sections had no sea growth but oxide and carbonate scale 1/8" thick.

The HCL solutions were 1/2, 3/4 and 1 normal, uninhibited. The ammonium citrate was of 1/2 and double strength. Single strength in this experimental work is defined as 24 lbs. citrate acid and 17 lbs. ammonium hydroxide per 50 gallons water.

The 1 and 3/4 normal hydrochloric acid removed practically all scale and growth and activity in one hour's time. The 1/2 normal hydrochloric acid required 3 hour's time to remove the activity. However, in the case of the copper nickel pipe, considerable marine growth remained at the end of this 3-hour period. The double strength pH solution removed practically all the activity and growth in eight hours' time, whereas the 1/2 strength had removed only 80% of the activity and practically no growth in 16 hours' time.

Figure 1 is a plot of time and hours vs. the activity of the various solutions used in this test. It should be noted that more complete removal was obtained at the end of the first hour in the case of 3/4 and 1 normal hydrochloric acid. This matter is being investigated further.

(10) USS BARTON - Decontamination of complete fire and flushing system with double strength ammonium citrate - CuNi lines.

This test was set up prior to conclusions being made in the laboratory regarding minimum strength and minimum time of operation. Previous experience on the USS LAFFEY indicated that double strength ammonium citrate at the end of 72 hours standing did not effect complete removal of radioactive matter and effected only 30% removal of sea growth. It was therefore decided to make the USS BARTON test of longer duration, with the exception of two branches of the system which were to be drained at earlier intervals.

[redacted]

If deteriment to this experiment is the fact that the USS BARTON salt water system as a whole contained only small amounts of sea growth, and the fact that few readings on the system were significant enough to record. In an effort to get more significant data 12 valves were dropped before the test so as to obtain inside readings (b + g). Results are summarized.

		Before	After	Hours	
Valve	A	0.002			
	B	0.017	0.009	92	Pipe free.
	C	0.084	0.003	92	Pipe free.
	D	0.002			
	E	0.002			
	F	0.006			
	G	0.072	0.006	92	Few barnacles remaining
	H	0.003			
	I	0.002			
	J	0.001			
	K	0.005			

M. E. TURNBAUGH
Lieutenant Commander, USN

J. E. HOWELL
Lieutenant, USN

[redacted]

UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley 4, California

October 3, 1946

[redacted]

From: Lt. G. W. Morrison (MC) USN

To: Captain W. E. Walsh (MC) USN
50 Fell Street
San Francisco, California.

Subject: Preliminary Studies Concerning Optimum Concentrations of Ammonium Citrate Solution Used to Decontaminate Salt Water Lines Containing Fission Product Activity.

Ammonium citrate solution was prepared to pH 6 and contained 24 pounds of citric acid and 17 pounds of ammonium hydroxide for every 25 gallons of water. Two more dilute solutions were also prepared, being one-half and one-tenth as concentrated as the above ammonium citrate solution. Sections of radioactive iron pipe four inches long and two and one-half inches in diameter and copper nickel pipe four inches long and four and one-fourth inches in diameter were immersed in separate beakers of citrate solution of the above mentioned concentrations. Samples of the solution were withdrawn at half-hour intervals for the first six hours and then hourly for the next six hours, after the experiment was started in order to determine the rate of removal of fission product activity, as well as the total amount of activity removed by the three solutions from the pipes during the duration of the experiment.

Results:

Iron Pipe: With respect to iron pipe, it was found that 93.6% of the activity was removed by the full strength solution; 91.5% by the one-half strength solution; and 89% by the one-tenth strength solution. Rust

[redacted]

and scale were removed in all cases except for some scale remaining in the pipe treated with the one-tenth strength solution.

Although the experiment was continued twelve hours, it was found that 70% of the removal of fission products was accomplished in the first three hours except in the case of the one-tenth strength solution. Decontamination of the pipe to the limit of the ability of the solutions was completed within the first ten hours in all cases. It is felt that one-half strength solution is the optimum strength both from the efficiency and economic point of view.

Copper-Nickel Pipe: With respect to the copper-nickel pipe, it was found that 91.5% of the activity was removed by the full strength solution, 73.6% by the half strength solution, and 57.5% by the tenth strength solution. The full strength solution removed all the marine growth from the inside of the pipe; the half strength solution removed about two-thirds of the growth; the tenth strength solution removed only about one-third of the growth.

It was apparent from this series of tests that the removal of about half of the total fission products removable by the solutions was accomplished within the first thirty minutes of the experiment. It is felt that the full strength solution is the most efficient strength for the decontamination of copper-nickel pipe.

Lt. G. W. Morrison (HC) USN

GWM/kt

cc: Capt. Maxwell
Dr. J. G. Hamilton
File

[redacted]

UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley 4, California

October 8, 1946

[redacted]

From: Kenneth G. Scott

Subject: Point of Action of Decontaminating Solutions

Memorandum to: Admiral T. A. Solberg

AMMONIUM CITRATE SOLUTION

This solution works as a complexing agent. Certain fission products and plutonium in the plus four valence state are attracted by citrate molecules and under optimum conditions form a "complex" or chemical bond. This attraction is great enough to remove plutonium and some of the rare earth fission products from the phosphates, carbonates and hydroxides which also offer absorbing surfaces to these materials when they exist in sea water and are brought in contact with them. Normally, most ships' scales are iron hydroxide (rust) and marine organisms which have calcarious structures which are primarily calcium carbonate and/or phosphate.

Boiler and evaporator scale are also primarily carbonates and sulphates of calcium. What happens then is that the complex formed with fission products and plutonium is greater with the citrate in the decontaminating solution than the attraction offered to the active atoms by the carbonates, hydroxides and phosphates already present. The mass of the total citrate as compared to the total carbonates, phosphates and hydroxides is also a factor since, for example, very low concentrations of citrate would not be able to compete with an enormous quantity of carbonates, phosphates and hydroxides. We do know, however, that one-tenth strength of the original citrate solution used*

*Twenty-four pounds of citrate acid, 17 pounds of ammonium hydroxide in 50 gallons of water.

[redacted]

is sufficient to take the activity and plutonium away from the iron hydroxide found in steel salt water lines.

With respect to the hydrochloric acid solutions, the mode of action is primarily a dissolving action upon the carbonates and phosphates and hydroxides which contain the activity. For example, calcium carbonate plus hydrochloric acid would result in evolution of the carbonate to carbon dioxide gas and the calcium would remain as calcium chloride which is soluble. The acid is used up in this reaction. Calcium phosphate would be dissolved in 1 normal acid and since the active atoms are incorporated with this material which is now in solution, they can be removed by the solution. The hydroxides present are neutralized by the acid and become soluble chloride salts which stay in solution and are removed with the acid plus its dissolved materials. Acid would also be used up in this procedure. Complete neutralization of the acid might cause the active atoms to stick on the surfaces, requiring decontamination, and for this reason sufficiently strong acid solutions have to be used for decontamination. It appears that 1 Normal acid is adequate.

Any washing away or dilution of complexing solutions such as citrate solutions does not offer any serious hazard since the activity would also be washed away at the same time. Your assumptions are correct in that none of the above reactions influence the radiations which are emitted by the fission products and plutonium, but rather allow them to be removed from the scene of operation.

Kenneth G. Scott

KGS/kt

cc: Capt. W. S. Maxwell
Doctor Joseph G. Hamilton

[redacted] XRD- 187

JNCLASSIFIED

DIRECTOR OF SHIP MATERIAL

TECHNICAL INSPECTION REPORT

Classification (~~Cancelled~~) (Changed to CONFIDENTIAL)
JOINT CHIEFS OF STAFF JCS 1735/33 DATED 15 APRIL 1949
By Authority of
By Mattie L. Haughtelin Date 10 AUG 1949

Radiological Decontamination of Target and Non-Target Vessels

RECEIVED BUSHIPS SECRET FILE
DATE
ROUTE TO
SHIPS FILE NO.
ROUTE SHEET
SERIAL NO. OF
COPY
REGISTERED MAIL NO.

VOLUME 3 OF 3

OPERATION CROSSROADS

JOINT TASK FORCE ONE

Classification changed to UNCLASSIFIED
by authority of TID 9022
JAH
(Signature) (Rank)

[redacted]

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DIRECTOR OF SHIP MATERIAL

TECHNICAL REPORT

RADIOLOGICAL DECONTAMINATION OF TARGET AND NON-TARGET VESSELS

Volume 3 of 3 Volumes

By:

J.J. Fee
Commander, U.S.N.

TABLE OF CONTENTS

NOTE: The above is a list of effective pages in this Volume.
This is Volume 3 of 3.

[redacted]

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APPENDIX IV

DECONTAMINATION AND SHIP CLEARANCE

DIRECTIVES

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[redacted]
014/TAS/jjm
Serial: 462

DIRECTOR OF SHIP MATERIAL
JOINT TASK FORCE ONE

31 July 1946.

DIRECTOR OF SHIP MATERIAL MEMORANDUM #13.

To: All Target Vessels.

Subj: Decontamination Procedures on Target Vessels.

1. Most target vessels are contaminated to a greater or less degree with fission products and therefore present varying degrees of radiological hazards which at the present time prevent reboarding. Decontamination procedures are being carried out at the present time in order to make it possible for portions of the crews of these vessels to return aboard to complete the decontamination procedures. It is expected to bring the radiological hazards now existing in general on the topside of these vessels to a point where it will be possible for personnel to be aboard for a period of at least four (4) hours at one time. Commanding Officers should therefore, organize boarding parties on this basis and in consideration of the conditions and procedures contained in this memorandum.

2. Fission products are sub-microscopic particles and therefore not visible to the eye and their presence can only be determined by the use of monitoring instruments. These products are extremely difficult to remove in as much as they are quite firmly imbedded in the paintwork, metallic structures, wooden decks and particularly in such absorbent materials as lines, clothing, bunting, etc. Great care must also be taken in all decontamination procedures to prevent personnel engaged in these operations from becoming contaminated themselves.

3. The following procedures will assist in re-establishing normal conditions. It is expected that procedures will have to be repeated a number of times in order to get effective results.

(a) Washing down entire ships including topside structures, decks, sides and all exposed gear. It has not been possible up to the present time to determine how much contamination exists below decks and these conditions must be determined as soon as boarding parties arrive.

(b) In order to carry out (a) above it will be necessary to gain access to certain below decks spaces to establish power, either by installed generators, ship's boilers, or by portable pumps available for this purpose. Access to the necessary spaces must be monitored carefully. It is hoped that because of the steps taken to close all openings below decks that below deck spaces will be relatively free of radiological hazards. However, attention is invited to the fact that hazards existing on one side of a deck or bulkhead also presents a hazard on the other side. For instance, it is quite certain that hulls of ships below the water line generally will be highly radioactive at this time and therefore it is desirable for all personnel to keep at a distance of at least two (2) feet from these portions of the hull except for short periods necessary to do essential work such as opening and closing valves, etc.

(c) The object of (a) above is to remove as much as possible of the less firmly attached fission products. Subsequently, it will be ssary to follow more drastic procedures in order to remove the remaining products; generally speaking, it will be necessary to remove by polishing, vigorous scrubbing, holystoning, or other means, at least a portion of all surfaces and carefully washing down all removed material and insure that it is washed overboard. At the present time, the Director of Ship Material is conducting experiments with foamite lye, flour slurrys, and other absorbent materials in the hope that some material available on the ships can be used to hasten the processes of decontamination. Damage to paint and appearance by using these methods are of no consequence.

4. The following precautions should be taken by all presonnel in these operations in order to prevent possible exposure to radiological hazards.

(a) Monitors must be present at all times during these operations.

(b) Do not remain on the ship beyond the tolerance hours set.

Enclosure (B) to Enclosure (F) to Director Ship Material Serial 00447

[redacted]

(c) All personnel to be fully clothed at all times and to have ~~a complete change of clothing and effective showers after each oper-ation in which they are engaged. In this connection it is desirable to~~ wear rubbers or boots and acid-resistant gauntlet type rubber gloves as these materials can be cleaned more easily. For instance, the fission products attach themselves more readily to leather. leather shoes, and leather gloves and are most difficult to remove even by laundering. All clothing worn must be laundered after each oper-ation. All contaminated clothing should wherever possible, be care-fully washed out separate and apart from the ship's regular laundry. For small amounts buckets and tubs can be utilized. Where the lots are so large as to make use of the ship's regular laundry facilities mandatory, the inside of the equipment should afterwards be thorou-ghly scurbbed with an abrasive soap, such as Bon-Ami.

(d) During any hosing or washing down operations, personnel should be to windward of all such operations in order to prevent spray-ing and wetting themselves and any other personnel on board. Great care must be exercised in this respect, particularly until the ship be-gins to reach normal conditions.

(e) Upper vertical surfaces will present the greatest dif-ficulties in decontamination and work on these surfaces must be con-trolled so as to prevent any spray or drippings falling on other per-sonnel.

(f) Access passages to the most used and most necessary spaces in the ship should be decontaminated as soon as possible, in other words, set up definite routes of access which must be used by all personnel until general clearance is obtained.

(g) Determine as soon as practicable what space below decks are free from contamination or relatively free from contamination and require personnel to remain in these spaces at such times as they are resting or eating.

(h) It will be necessary to use K-rations at least in the be-ginning and these should be brough daily rather than in large supplies, and a space free from contamination used for keeping them until meal hour. Fresh water in canteens must be brought each day and handled in the same way.

(i) Determine as soon as practicable the condition of consum-able supplies which may have been left on board and also condition of stored fresh water. Samples of suspected or definitely contaminated materials should be brought to the U. S. S. HAVEN properly tagged and identified for further examination. It is desirable that the fresh water from all storage tanks be so tested before using.

(j) All radiological dangers, when found, shall be marked clearly and if necessary roped off to keep personnel at a safe distance.

5. It is expected that the decontamination procedures on all ships will be rather slow and certainly laboruous. Only by careful attention to the above instructions can effective results be obtained in the least amount of time. The Director of Ship Material group and the Radiological Safety Section will cooperate so as to insure that no personnel are subjected to any over-exposure or other hazards. Monitors will be used until the entire ship has been decontaminated, inspected, and declared to be within safe tolerance limits for all personnel to reboard on a twenty-four (24) hour basis.

6. The above instructions have been approved by the Radiological Safety Section.

T. A. SOLBERG.

cc:
- CJTF-1
- CTG 1.2
- CTU 1.2.7
- Colonel Warren
- File

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[redacted]

JOINT TASK FORCE ONE
DIRECTOR OF SHIP MATERIAL
TARGET PREPARATION AND INSPECTION OFFICE

014K1/EJH/naa/S88 4 August 1946.

<u>DIRECTOR OF SHIP MATERIAL MEMORANDUM No. :</u>

From: Director of Ship Material.
To : CTU 1.2.7
TU 1.2.7
All DSM Initial Boarding Teams
All Target Vessels.

Subject: Preliminary Decontamination of Target Vessels by Ships of TU 1.2.7.

Ref: (a) DSM Memorandum No. 13 of 31 July 1946.

Encl: (A) Instructions for mixing and applying Paint Removal Mixture.

1. Reference (a) outlined the procedures to be followed by the ship's force in rehabilitating the various contaminated target vessels. once a tolerable level of radioactivity obtains. Many of the target vessels at present have such radioactive contamination that the ship's forces can not work aboard a sufficient length of time to safely and effectively use the procedures given in reference (a). Therefore, it will be necessary to take preliminary steps to clear the vessels sufficiently to permit the ship's force to pick up the ball. This preliminary decontamination procedure should reduce the radiation intensities to permit at least four hours' working time for the ship's force over substantial areas of the topsides of the target vessels.

2. The preliminary decontamination procedure that shows promise of accomplishing the desired results is best accomplished by vessels of TU 1.2.7. The steps that comprise this procedure are as follows:

Enclosure (C) of Enclosure (F) to Director of Ship Material Serail 00447

[redacted]

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(a) A through wash down with plain water. This removes some of the likelihood of contamination of boarding personnel.

(b) The radiological monitor, DSM representative, and ship's force representative will then make a quick preliminary survey of the target vessel noting general average Roentgen readings and also any hot spots which may be present. Together with the Commanding Officer of the salvage vessel, a plan of action will be laid out prior to going to work on the ship which in some cases would use up tolerance time needlessly.

(c) If conditions permit, the ship's force working party will then board the target vessel and remove all life rafts, canvas not protecting an interior space, exposed manila, fire hose, and the like for which no suitable decontamination procedure has been devised and which have been found to be uniformly hot. The working party will be worked in relays to avoid over exposure and will be returned to the hotel transport upon completion. When the target ship is too hot to permit this to be done at this time, the operation will be accomplished after (f) below.

(d) After removal of canvas, life rafts, etc., the target vessel is sprayed with the paint removal mixture in accordance with enclosure (A).

(e) After an interval of approximately two hours the ship is again hosed down. This wash down is for the purpose of removing paint. The maximum force of the fire monitors must be applied to all painted surfaces to accomplish this end. All decks and platforms should be swept with the hose upon completion to remove all paint chips possible from the ship. This washing should proceed from the top of the target vessel downward to avoid recontaminating an area that has been cleaned below. Where contaminated paint chips are washed down on a wood deck they should be frequently swept clear (by the fire monitors) to avoid transferring contamination to the wood. Care should be taken to avoid holidays in the removal job as it is more effective to do a comparatively small part of the ship thoroughly than the whole ship in a haphazard manner. When the paint removal mixture has been properly applied, at least the top coat of paint should be removed by this washing, and the radioactivity level substantially reduced.

(f) The target vessel should then be reboarded by the DSM representative with a monitor and a responsible officer from the target vessel. The general radiation level will be checked at this boarding to ascetain whether or not the vessel is suitable for application of decontamination methods outlined in reference (a). All hot spots should be noted and the source of the excessive radiation determined if practicable. If the hot spot is extensive and apparently due to holidays in removal of paint from large surfaces it may be necessary to repeat the applicable steps in the procedure to clear up the hot spot.

3. When the first preliminary survey of radiological conditions is made, consideration must be given to the length of time a salvage or fire fighting vessel can lay alongside without exceeding the tolerance. Step (e) in the procedure will require the longest time interval estimated at about four hours per destroyer and a correspondingly longer time for larger vessels. It is very desirable to actually put a line over to the target vessel to permit laying alongside and performing an effective job of washing down. Care should be exercised in all washing down to avoid washing contaminated materials into the target vessels or upon the salvage vessel concerned. In some cases danger exists of introducing large amounts of water into the ships. It may be necessary to skip certain areas of the ship, such as around open hatches on APA's, large air intakes on all vessels which are not fitted with suitable closures, etc.

4. During the entire decontamination a representative of the Director of Ship Material and an officer representative of the target vessel being worked on will be present. Radiological safety monitors are aboard all TU 1.2.7 vessels which are assigned to this work. The duties of these officers will be to see that the provisions of this memorandum are safely and effectively carried out. They will maintain liaison with the DSM organization and the commanding officer of the target vessel, make such reports and recommendations as are normally made by Initial Boarding Teams and, as circumstances warrant, arrange for working parties from the target vessel, etc.

5. Many of the life rafts, some of the canvas and other materials removed in step (c) above will be required if the target ship is to return under her own power to the port designated for ultimate disposition. The life rafts should be secured close aboard astern of the target ships. Contaminated fire hose, manila and essential canvas may be loaded into them. Somewhat limited ex-

perience would indicate that this may be a satisfactory decontamination procedure for these materials. Care must be exercised in handling these highly radioactive materials to avoid insofar as practicable, contamination of the clothes and persons of the working party.

T. A. SOLBERG,
Rear Admiral, U.S. Navy.

Copy to:
CJTF-1
CTG 1.2
CTG 1.3
CTG 1.8

Enclosure (C) to Enclosure (F) to Director Ship Material Serial 00447

PRELIMINARY [redacted]

Enclosure (A) To DSM Memorandum No.___.

Subject: Instructions for Mixing and Applying the Paint Removal Mixture.

1. All vessels which are to be assigned to apply the Paint Removal Mixture have been fitted with tanks of about 1000 gallon capacity for preparing and holding the Paint Removal Mixture. This mixture will be applied by using a Chrysler salvage pump taking suction from the tank and supplying a 1 1/2" hose at suitable pressure to reach the surface it is desired to coat. The 1 1/2" hose may be fitted with an all purpose nozzle or a long handled applicator with a modified fog nozzle attachment as appropriate for the work to be accomplished. All painted surfaces of the target vessel should be thoroughly coated, although it is undesirable to apply so much that pools of the mixture form on the deck or pour out of the scuppers, inasmuch as the supply of materials in the area is limited and effort is expended in mixing wasted material. The maneuvering of the salvage or fire-fighting vessel and the pressure on the pump should be varied as circumstances warrant to secure complete coverage of all the painted surfaces and to reduce the wastage to a minimum. It will probably be found desirable and necessary to make several passes at the ship to be sprayed in order to obtain the desired results with the least exposure.

2. The Paint Removal Mixture is composed of lye, boiler compound and cornstarch. The amounts required for 1000 gallons of mixture are 450 lbs. of lye. 600 lbs. of boiler compound and 75 lbs of cornstarch. About 500 gallons of fresh water should be put in the tank and the lye and boiler compound added gradually and thoroughly mixed and dissolved. The cornstarch should be made into a thin suspension separately in buckets or G.I. cans and added gradually with continuous stirring to obtain a final mixture free of lumps. Fresh water to make 1000 gallons should be added at this time. The whole batch should then be heated by a steam hose until the starch swells and the boiler compound completely dissolves. The mixture will now have the consistency of a thin paste. It will be uniform and capable of

being applied in the manner outlined. If a ready source of steam is not available for cooking the formula, the cornstarch will have to be cooked separately in a galley kettle until thickened and then added and stirred into the mixture until it has a uniform consistency.

3. In mixing and supplying the Paint Removal Mixture it must be borne in mind that the lye mixture will produce painful burns if splashed on the skin. If it gets into the eyes, it may be dangerous as well as painful. Therefore, it will be necessary to take due precautions to prevent injuries by wearing of suitable protective clothing by necessary personnel. All unnecessary men should be kept clear of the areas where the mixture is being handled. Suitable first aid materials such as boric acid ointment and eyewash should be broken out and the pharmacist's mate should be alerted to take care of any minor casualties should they occur.

[redacted]

FROM: CINCPAC

TO: ALPAC 238

INFO: CNO
BUSHIPS
COM 11/COMWESSEAFRON
COM 12/CJTF-1
COMDR ALL NAV TG JTF-1
COM 13/ COM 14

4 SEPT 46

032333Z

NCR 9560

ALL VESSELS AND SMALL BOATS INCLUDING SMALL LANDING CRAFT WHICH HAVE BEEN EXPOSED TO RADIOLOGICAL CONTAMINATION AS A RESULT OF CROSSROADS WILL BE TREATED AS FOLLOWS UNTIL DEFINITELY PROVEN SAFE BY MONITOR GROUPS TO BE ESTABLISHED AT SAN FRANCISCO, KWAJALEIN, GUAM AND UNTIL DETAILED INSTRUCTIONS ARE PROMULGATED BY CJTF-1.

(A) VESSELS SHALL NOT BE DRYDOCKED.
(B) WORK WILL NOT BE UNDERTAKEN WHICH INVOLVED EXPOSURE OF PERSONNEL TO FUMES DUE TO WELDING OR CUTTING, OR TO DUST, IF ORIGINATED FROM SURFACES CONTAMINATED BY SEA WATER.

(C) BOATS DECLARED RADIOLOGICALLY SAFE WILL BE SUNK IN DEEP WATER NOT BURNED.

(D) BOATS DECLARED RADIOLOGICALLY SAFE WILL BE RETAINED AND TREATED AS NORMAL BOATS.

SINKING OF CONTAMINATED BOATS AT KWAJALEIN AUTHORIZED. CNOB GUAM AUTHORIZED TO DESIGNATE SUITABLE REPRESENTATIVE KWAJALEIN TO INSURE COMPLIANCE

[redacted]

CANO 302200 NOT TO ALL

CJTF-1 ...COG
20F...OP03(33)...20K...BUSHIPS...BAD...414...OP04...20P...ALPAC.

032333Z/238

[redacted]

NOTE: THIS DIRECTIVE PARTIALLY SUPERSEDED CJTF1 SERIAL 0.9 OF 9 SEPTEMBER 1946. (SEE APPENDIX II)

BUSHIPS Code 180
All/Crossroads/FS/L9
All/Crossroads (P2)
Serial 1381

NAVY DEPARTMENT
BUREAU OF SHIPS
and
BUREAU OF MEDICINE AND SURGERY
WASHINGTON 25, D. C.

BUMED
A4-1/FS

[redacted]
AIRMAIL

SPEEDLETTER

24 SEPTEMBER 1946

TO: CINCPAC
COMWESSEAFRON
COMSERVPAC
COMTWELVE
COM19THFLT

SUBJECT IS RADIOLOGICAL CLEARANCE OF NON TARGET VESSELS AND PROCEDURES FOR DECONTAMINATION X BUSHIPS HAS BEEN ASSIGNED COGNIZANCE OF DECONTAMINATION PROCEDURES PLUS SAFE OPERATING AND MAINTENANCE METHODS IN CASES OF ALL VESSELS EXPOSED TO RADIOACTIVITY X BUMED ASSIGNED RESPONSIBILITY FOR DETERMINING SAFE RADIOLOGICAL LIMITS X THESE BUREAUS WILL ACT JOINTLY IN GIVING FINAL RADIOLOGICAL CLEARANCE TO VESSELS AFTER REVIEWING REMAINING IN ACTIVE SERVICE X REFERENCE COMJOINT TASK FORCE ONE SERIAL ZERO SEVEN NINE OF NINE SEPTEMBER X WHERE INFORMATION AND INSTRUCTIONS THIS SPEEDLETTER CONFLICT WITH REFERENCE THIS SPEEDLETTER WILL APPLY X

ABLE X EVAPORATORS X OPEN SUMP OR OTHER CLEAN OUT DOORS AND REMOVE ALL LOOSE SCALE UNDER WET CONDITIONS X COLLECT ALL SCALE CAREFULLY IN CLOSED CONTAINERS AND SEGREGATE UNTIL DISPOSAL AT SEA IS PRACTICABLE X SUBSEQUENTLY CARRY OUT ONE ACID CLEANING PROCESS X USE TWO PARTS EIGHTEEN DEGREE BAUME COMMERCIAL MURIATIC ACID WITH FIFTEEN PARTS FRESH WATER X FILL EVAPORATORS WITH THIS SOLUTION TO TOP OF TUBE NESTS X CIRCULATE MIXTURE THROUGH SHELLS AND EVAPORATOR FEED HEATERS

[redacted]

FOR TWO HOURS BEGINNING WITH TIME SOLUTION IS STARTED INTO SHELLS X REMOVE SOLUTION AND FLUSH THOROUGHLY X OBSERVE USUAL PRECAUTIONS HANDLING ACIDS X DO NOT RE PEAT NOT HEAT SOLUTION X THE ABOVE PROCEDURE APPLIES TO ALL TYPES OF EVAPORATORS EXCEPT BADGER TYPES HAVE DOUBLE ABLE AND TRIPLE ABLE TYPES HEAT EXCHANGERS X FOR THESE UNITS BOIL OUT FOR NINE SIX HOURS AT TEMPER ATURE OF TWO HUNDRED FAHRENHEIT USING ONE POUND BOILER COMPOUND TO TEN GALLONS FRESH WATER X USED ACID MIX TURE TO BE COLLECTED AND DISPOSED OF AT SEA X NO RE PEAT NO ADDITIONAL ACID CLEANINGS ARE NECESSARY AND EVAPORATORS SUBSEQUENTLY ARE TO BE OPERATED AND MAIN TAINED IN ROUTINE MANNER X

BAKER X LUBRICATING OIL COOLERS AND OTHER HEAT TRANS FER APPARATUS (EXCEPT CONDENSERS) USING SALT WATER FOR COOLING X IF MONITORS HAVE SHOWN EXISTENCE OF ANY MEASURABLE RADIATION USE ONE ACID TREATMENT FOR SALT WATER SIDE AS IN ABLE ABOVE EXCEPT USE ACID IN ONE HALF OF THE PROPORTION SPECIFIED X SUBSEQUENT OPERATION AND MAINTENANCE WILL BE REQUIRED X VESSELS OF TASK UNIT 1.2.7 (SALVAGE UNIT) GENERALLY HAD CONTAMINATED COOLERS BECAUSE OF THEIR EXTENSIVE EMPLOYMENT IN RADIOACTIVE WATERS X CHARLIE X DESIRE ABLE AND BAKER CARRIED OUT AS SOON AS PRACTICABLE: PREFERABLY BY SHIPS FORCE X BUT NOT REPEAT NOT TO INTERFERE WITH SCHEDULED OPERATIONS X

DOG X DOCKING X ALL VESSELS CAN BE DOCKED WHEN DESIRED X FOLLOWING PROCEDURE APPLIES FIRST DOCKING ONLY AFTER LEAVING BIKINI LAGOON X MARINE GROWTHS TO BE REMOVED BY SCRAPERS AS DOCK IS PUMPED DOWN X PUMPING RATE TO BE ADJUSTED SO THAT MARINE GROWTH IS KEPT WET X COL LECT ALL MARINE GROWTH PRACTICABLE FROM DOCK, KEEP IT WET AT ALL TIMES AND DUMP AT SEA BEYOND ONE HUNDRED FATHOM LINE OR AT LEAST TEN MILES AT SEA X

EASY X SANDBLASTING AND PAINTING UNDERWATER BODY X CARRY OUT REGULAR WET SANDBLASTING PROCEDURE INSURING WET CONDITIONS X KEEP DOCK FLOOR WET DURING OPER ATION X COLLECT ALL OF SAND PRACTICABLE MAINTAINING

WET CONDITION UNTIL DUMPED AT SEA AS IN DOG ABOVE X

FOX X DESIRE DOG AND EASY ABOVE CARRIED OUT AT FIRST SCHEDULED DOCKING OF VESSELS INVOLVED X

GEORGE X MONITORS ARE DESIRABLE BUT NOT REPEAT NOT ESSENTIAL FOR ABOVE OPERATIONS IF CARRIED OUT AS DIR ECTED HEREIN X MONITORS SHOULD BE REQUESTED FROM RADIOLOGICAL SAFETY OFFICER TWELFTH NAVAL DISTRICT AND WILL BE FURNISHED IF PRACTICABLE X

HOW X SALT WATER LINES X TESTS HAVE DEMONSTRATED THAT ALL ROUTINE REPAIRS INVOLVING CUTTING AND WELDING CAN BE PERFORMED BY SHIPS AND YARDS WITH NO REPEAT NO DANGERS BEING INVOLVED X HOWEVER IN ALL CASES WHERE A SECTION OF LINE IS RENEWED THE OLD SECTION SHALL BE RE TAINED, SEGREGATED AND DUMPED AT SEA X ANY FOULING REMOVED FROM SALT WATER LINES SHOULD BE HANDLED AND DISPOSED OF AS IN ABLE ABOVE X

ITEM X MAIN AND AUXILIARY CONDENSERS X RENEW ALL ZINCS, SEGREGATE AND DISPOSE OF AT SEA X TO BE DONE AS SOON AS PRACTICABLE BY SHIPS FORCE X

JIG X SHIPS BOATS X ANY BOATS NOT REPEAT NOT ALREADY DISPOSED OF WILL BE RETAINED AND TREATED AS FOLLOWS X SCRUB ENTIRE HULL THOROUGHLY WITH STRONG MIXTURE OF LYE AND BOILER COMPOUND X USE LONG HANDLED SCRUBBERS AND REMOVE AS MUCH OF PAINT AS PRACTICABLE IN THIS OPER ATION X SUBSEQUENTLY REPAINT WITH FOUR COATS OF PAINT X RUDDERS AND SCREWS ALSO SHOULD BE SCRUBBED WITH ABOVE MIXTURE X IF MONITORS HAVE REPORTED ANY ACTIVITY IN ENGINES OR COOLERS CIRCULATE ACID MIXTURE AS IN BAKER ABOVE X EXHAUST PIPE TAILS SIMILARLY REPORTED ACTIVE SHOULD BE RENEWED AND DUMPED AT SEA X FENDERS AND CANVAS REPORTED ACTIVE SHOULD BE RENEWED AND SUNK AT SEA X TO BE DONE AS SOON AS PRACTICABLE BY SHIPS FORCE X

KING X STRUCTURAL REPAIRS ON THESE VESSELS ARE NOT IN VOLVED AND CAN BE PERFORMED WITH NO RESTRICTIONS X

[redacted]

LOVE X BUSHIPS WILL ISSUE ANY FURTHER INSTRUCTIONS OR MODIFICATIONS REQUIRED X MAKE REPORTS ON ITEMS ABOVE WHEN ACCOMPLISHED TO BUSHIPS AND BUMED AND TO RADIO LOGICAL SAFETY OFFICER COMTWELVE X NOTE THAT IN EACH CASE ABLE THROUGH JIG THE SPECIFIED OPERATION IS REQUIRED TO BE PERFORMED ONLY ONCE X SUBSEQUENTLY CONDITIONS WILL BE THE NORMAL ONES WHICH WILL REQUIRE NO REPEAT NO FURTHER PRECAUTIONS AND SPECIAL CONSIDERATIONS X

MIKE X TESTS AND DEVELOPMENT WORK HAVE DEMONSTRATED THAT ALL OF THE ABOVE SPECIFIED PROCEDURES CAN BE CARRIED OUT SAFELY AND WITHOUT EXPOSING PERSONNEL TO ANY HAZARDS X HOWEVER IN ORDER TO INSURE ABSOLUTE SAFETY PERSONNEL SHOULD BE SUPERVISED AND PRECAUTIONS DESCRIBED IN REFER ENCE LETTER OBSERVED X THE RADIOACTIVITY PRESENT IS OF VERY LOW INTENSITY X SOME OF THE PROCEDURES SPECIFIED ARE FOR SECURITY REASONS ONLY X

NAN X VESSELS BEING DEACTIVATED AND THOSE SCHEDULED FOR DISPOSAL WILL REQUIRE SOMEWHAT DIFFERENT INSTRUC TIONS X THESE WILL BE PROMULGATED AT AN EARLY DATE BY BUREAU OF SHIPS X

OBOE X ADDRESSEES PASS TO TYPE COMMANDERS AND VESSELS INVOLVED X

PETER X REQUEST RADIOLOGICAL SAFETY OFFICERS IN HAVEN AND SAN FRANCISCO FURNISH BUSHIPS CODE 180 AND BUMED COPIES OF ALL MONITOR REPORTS TO DATE AND FUTURE MON ITORINGS X

ROSS T MCINTIER
CHIEF OF THE BUREAU OF
MEDICINE AND SURGERY

E L COCHRANE
CHIEF OF THE BUREAU
OF SHIPS

CC: CNO
CJTF1
NAVSHIPYDS, PUGET SOUND
NAVSHIPYDS, MARE ISLAND
NAVSHIPYDS, SANFRAN
NAVAL SHIP REPAIR BASE, GUAM
NAVSHIPYDS, TERM ISLAND
NAVSHIPYDS, PEARL
RADSAFE IN HAVEN
RADSAFE COMTWELVE
NAVAL SHIP REPAIR BASE, SAN DIEGO

UNCLASSIFIED

All/Crossroads/FS/L9(180)
All/Crossroads (P2)
Serial No. 1383

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON, 25, D. C.

26 SEPTEMBER 1946

[redacted]
AIRMAIL

SPEEDLETTER

TO: CINCPAC
COMWESSEAFRON
COMSERVPAC
COMTWELVE
COM19THFLT

REFERENCE BUSHIPS BUMED SPEEDLETTER SERIAL 1383 OF 24
SEPTEMBER X MODIGY PARAGRAPH ABLE AS FOLLOWS X DE
LETE SENTENCE QUOTE FILL EVAPORATORS WITH THIS SOLU
TION TO TOP OF TUBE NESTS UNQUOTE X SUBSTITUTE FOR
THIS SENTENCE THE FOLLOWING QUOTE X FILL EVAPORATORS
WITH THIS SOLUTION TO AS NEAR TOP OF SHELL AS PRACTIC
ABLE X TAKE NECESSARY STEPS TO PREVENT SOLUTION SPIL
LING OVER INTO ANY PART OF FRESH WATER SYSTEM BY
BLANKING OFF AT PIPE FLANGES AS NECESSARY X UNQUOTE X
DELETE SENTENCE ALSO IN PARAGRAPH ABLE QUOTE X REMOVE
SOLUTION AND FLUSH THOROUGHLY UNQUOTE REPLACE WITH
FOLLOWING SENTENCE QUOTE X REMOVE SOLUTION FLUSH
THOROUGHLY USING BOILER COMPOUND IN FLUSHING WATER
UNTIL REMAINING ACID IS NEUTRALIZED X FINALLY FLUSH
THOROUGHLY WITH FRESH WATER X INSURE BY TESTS THAT
NONE OF ACID SOLUTION HAS GAINED ACCESS TO ANY PORTION
OF ENTIRE SYSTEM WHICH NORMALLY IS IN CONTACT WITH
FRESH WATER OR VAPOR X UNQUOTE

S S KENNEDY
By Direction
Asst. Chief of Bureau
for Ship Maintenance

CC: CNO
BUMED
CJTF1
NAVSHIPYD, PUGET SOUND
NAVSHIPYD, MARE ISLAND
NAVSHIPYD, SAN FRAN
NAVSHIPYD, TERM ISLAND
NAVSHIPYD, PEARL
RADSAFE IN HAVEN
RADSAFE COMTWELVE
NAVAL SHIP REPAIR BASE, SAN DIEGO
NAVAL SHIP REPAIR BASE, GUAM

[redacted]

UNCLASSIFIED

[redacted]

FROM BuShips Code 180 Solberg/ 022120Z
TO ComWesSeaFron
INFO BuMed, CNO, CJTF-1, Com19thFlt, Com-12.

URDIS 271945Z X HIGHLY DESIRABLE ACCOMPLISH APPLIC ABLE ITEMS SPECIFIED IN SPEEDLETTER 1381 ON ALL VES SELS X ADDITIONAL WORK ON SALT WATER LINES OF IN ACTIVE AND DISPOSAL VESSELS WILL BE AUTHORIZED SOON WHEN PROCEDURES ARE PERFECTED X SPECIAL DOCKING OF CONTAMINATED DISPOSAL VESSELS NOT REPEAT NOT YET DECIDED.
2120/02 OCT MJ 022120# 271945 1381

[redacted]

[redacted]

FROM: BUSHIPS/BUMED/141550Z
TO : CWSF

INFO : CNO
COM 11
COM 12
COM 13
COM 14
CJTF-1
CINCPAC
COMNAVSHIPYD PEARL
COMNAVSHIPYD BREMERTON
COMNAVSHIPYD TERMINAL I
COMAIRPAC
NAVREPBASE GUAM
COMMARIANS
COMBATCRUPAC
COMSERVPAC
COMNAVSHIPYD SAN FRAN
COMSHIPREPBASE SAN DIEGO
RADSAFE KWAJALEIN
COMPHIBSPAC
COM19THFLEET
COMDESPAC
COMNAVPHIL

SHIPS FORCE ALL CROSSROADS NON TARGET VESSELS AUTH ORIZED PROCEED IMMEDIATELY WITH ONE ACID CLEANING

EVAPORATORS ACCORDANCE JOINT BUSHIPS BUMED SPDLTR SERIAL 1381 AND BUSHIPS SPDLTR SERIAL 1383 ALSO ONE ACID

CLEANING SALT WATER SYSTEMS INCLUDING FOREMAIN FLUSHING COOLING AND DRAINAGE PIPING COMMA PUMPS COMMA COOLERS AND OTHER HEAT TRANSFER APPARATUS EXCEPT CONDENSERS

USING FOLLOWING METHOD X ABLE X FILL SYSTEM WITH SOLUTION OF ONE GALLON EIGHTEEN DEGREE BUMED COM

MERCIAL MURIATIC ACID TO TEN GALLONS FRESH WATER AND IF AVAILABLE TWO OUNCES OF INHIBITOR EITHER OR RODINE

41 OR RODINE 67 X BAKER X AFTER SYSTEM IS FILLED LET SOLUTION STAND FOR ABOUT FOUR HOURS X CHARLIE X DRAIN

AND FLUSH THOROUGHLY WITH SALT WATER FOR THIRTY MIN UTES X DOG X FLUSH SYSTEM WITH NEUTRALIZING SOLUTION OF BOILER COMPOUND UNTIL TESTS SHOW ALKALINE REACTION X

[redacted]

USED ACID SOLUTION TO BE DISPOSED OF AT SEA X USE STAND ARD SAFETY PRECAUTIONS FOR HANDLING ACID X ABOVE CLEANING MAY SLIGHTLY AFFECT OLD VALVE STEM PACKING AND GASKETS BUT IN MOST CASES NO SERIOUS DAMAGE WILL RESULT X BOIL OUT SALT WATER SIDES OF MAIN AND AUXILI ARY CONDERSERS USING PROCEDURE SPECIFIED FOR CLEANING STEAM SIDES AS OUTLINE BY PARA FOUR SIX DASH FIVE EIGHT BUSHIPS MANUAL 1946 X REPORTS OF COMPLETION OF WORK SHOULD BE MADE TO BUSHIPS WITH INFO TO INTERESTED COM MANDS X FOR WORK ON ALL NON TARGET VESSELS NO SPECIAL PROTECTIVE CLOTHING OR DEVICES REQUIRED X SKIN CON TACT WITH CONTAMINATED MATERIALS SHOULD BE AVOIDED AND PERSONNEL ACTUALLY HANDLING THEM SHOULD WEAR GLOVES WHICH MAY BE DISCARDED ON COMPLETION OF JOB X PERSONNEL CLEANING MARINE GROWTH FROM SHIPS SIDES IN DRYDOCK SHOULD WEAR ORDINARY LONG SLEEVED WORK CLOTHING CAP GLOVES AND RUBBER BOOTS X SAND BLASTING CREWS REQUIRE ONLY CLOTHING ORDINARILY WORN IN THIS OPERATION X COMPLETE DETAILED INSTRUCTIONS FOR WORK REQUIRED FOR FINAL CLEARANCE ALL NON TARGET VESSELS BEING PREPARED X COMMANDER HOFFMAN NOW AT NAVSHIP YARD SANFRAN IS BUSHIPS REP AVAILABLE FOR CONSULATION ON ANY NECESSARY DETAILED INFORMATION X MONITORS NOT REQUIRED FOR THESE OPERATIONS BUT SHOULD BE USED IF AVAILABLE X COMPLETE MONITORING AFTER WORK IS COM PLETED IS REQUIRED X SHOULD BE REQUESTED AT FIRST OP PORTUNITY AFTER ARRIVAL IN PORT X THIS AMPLIFIES JOINT BUSHIPS BUMED SPDLTR SERIAL 1381 AND TO BE USED IN CON NECTION THEREWITH X

FROM: BUSHIPS
TO : CINCPAC
COMWESSEAFRON

25 OCTOBER 1046

INFO: COMSERVPAC
COMBATCRUPAC
COMDESPAC
COMINPAC
COMPHIBSPAC
COMSUBPAC
COMAIRPAC

CJTF-1
BUMED
CNO
COM 11, 12
COM 13, 14
COMMARIANAS

242130Z NCR 167

REQUEST ALL CROSSROADS NON TARGET VESSELS EXCEPT THOSE WITH FINAL RADIOLOGICAL CLEARANCE BE DIRECTED

INITIATE SOON AS PRACTICABLE AND EXPEDITE ALL POSSIBLE DECONTAMINATION OF EVAPORATORS AND SALT WATER SYSTEMS

ACCORDANCE JOINT BUSHIPS BUMED SPDLTR SER 1381, BUSHIPS SPDLTR SER 1383 AND BUSHIPS DISPATCH 141550Z XXX

BUSHIPS...ORIG
CJTF-1...BUMED...OP04...414...OP03(33)...

[redacted]

242130Z

BUSHIPS Code 180
All/Crossroads/S99-(2)

NAVY DEPARTMENT
BUREAU OF SHIPS
and
BUREAU OF MEDICINE AND SURGERY
WASHINGTON 25, D.C.

6 November 1946

[redacted]
A-I-R M-A-I-L

SPEEDLETTER

TO: COMWESSEAFRON

RE BUSHIPS BUMED 141550Z OCTOBER X DELETE PORTION READING QUOTE BOIL OUT SALT WATER SIDES OF MAIN AND AUXILIARY CONDENSERS USING PROCEDURE SPECIFIED FOR CLEANING STEAM SIDES AS OUTLINED PARA FORTY-SIX DASH FIFTY-EIGHT BUSHIPS MANUAL NINETEEN FORTY-SIX UNQUOTE X SUBSTITUTE THE FOLLOWING QUOTE CONDUCT ONE ACID CLEANING OF SALT WATER SIDES OF ALL CONTAMINATED CONDENSERS EXCEPT MAIN CONDENSERS USING A ONE-HALF NORMAL SOLUTION OF EIGHTEEN DEGREE BAUME COMMERCIAL MURIATIC ACID AND FRESH WATER X ALLOW SOLUTION TO STAND IN CONDENSERS FOR ONE HOUR X DRAIN OFF ACID FLUSH THOROUGHLY WITH SALT WATER THEN NEUTRALIZE WITH BOILER COMPOUND SOLUTION AND REFLUSH X UPON COMPLETION OF CLEANING MAKE COMPLETE INSPECTION OF CONDENSER WITH SPECIAL ATTENTION TO TUBE ENDS WHICH ARE PACKED X CONDUCT TIGHTNESS TEST X UNQUOTE X

T.A. SOLBERG
By direction of
Chief of Bureau

cc: ComEleven
ComTwelve
ComThirteen
ComFourteen
CNO
CinCPac
ComServPac
Com19thFlt
ComNavShipydPearl
ComNavShipydBrem
ComNavShipydSF
ComNavShipYd TI
ComNavRepBase SD
ComNavShipYd MI
RadSafe Kwaj
ComMarianas
ComBatCruPac
ComDesPac
ComAirPac
NavRepBaseGuam
ComNavForPhil
ComPhibsPac

[redacted]

[redacted]

P2-4
(WSF-07-bn)
Serial: 0564

Staff Headquarters
WESTERN SEA FRONTIER
Federal Office Building
San Francisco 2, California

[redacted]

18 November 1946

From: Commander Western Sea Frontier
To: Commandant Eleventh Naval District
Commandant Twelfth Naval District
Commandant Thirteenth Naval District
Commandant Fourteenth Naval District

Subj: Radiological Monitoring Organization.

Ref: (a) CJTF-1 Conf. ltr. JTF-1/J-3, L9-7, Serial 079 of 9 September 1946.
(b) CNO Conf. ltr. Op-602/cm serial 021P602(Sc) S67-1 of 27 August 1946.
(c) Joint BuShips-BuMed Conf. Spdltr. Serial 1331 of 24 September 1946.

1. Reference (a) established the initial organization for radiological monitoring and clearance of Bikini vessels. With the dissolution of Joint Task Force ONE, a modified organization for continuing the monitoring and clearance of contaminated vessels has been established and supersedes that constituted by reference (a). The nature and functions of the new organization are set forth below for information and guidance.

2. A radiological safety organization is established at Naval Shipyard San Francisco under Commander Western Sea Frontier to Coordinate monitoring and clearance of all crossroads vessels on the West Coast and Pearl Harbor areas. This organization performs the following functions:

(a) Distributes monitor and radiological detection instruments as required and available to Commandants of the Eleventh, Twelfth, Thirteenth and Fourteenth Naval Districts.

[redacted]

P2-4
(WSF-07-bn)
Serial: 0564

18 November 1946

[redacted]

Subj: Radiological Monitoring Organization

- -

(b) Furnishes technical instructions and field guidance to radiological monitors in accordance with instructions received from the Bureau of Ships.

(c) Maintains complete records as to the radiological status of all suspect vessels and keeps files of all monitor reports.

(d) Maintains a Ship Clearance Board consisting of qualified personnel to review monitor reports, advise commanding officers as to decontamination measures required for operational and final clearance, and submit recommendations to Commander Western Sea Frontier for granting operational clearance and to Bureau of Ships and Bureau of Medicine and Surgery for granting final clearance.

3. Requests for monitoring by Crossroads vessels will be submitted to District Commandants in which vessels arrive or are located on the West Coast or Pearl Harbor areas. Monitoring offices are established at Naval Shipyards Puget Sound, San Francisco, Mare Island, Naval Base Commands Terminal Island and Pearl Harbor, and Eleventh Naval District Headquarters.

4. Upon completion of each monitoring of a Crossroads vessel, the local monitor office will provide the Commanding Officer of the vessel with an immediate report of the results obtained, will advise him as to what portions of the vessel require decontamination, and will insure that all applicable Bureau of Ships directives as to prescribed decontamination measures are available on board. It is necessary to observe, however, that the monitor acts in an advisory capacity only, and any recommendations he may make are subject to review and modification by the Ship Clearance Board. The Senior

[redacted]

P2-4
(WSF-07-bn)
Serial: 0564

18 November 1946

[redacted]

Subj: Radiological Monitoring Organization

- -

Monitor in each area will forward immediately to BuShips (Code 180A), BuMed (RadSafe), Commander Western Sea Frontier and RadSafe Headquarters Naval Shipyard San Francisco a full report on each vessel monitored. All copies of monitor reports must be signed by the monitors performing inspections.

5. Commander Western Sea Frontier will grant operational clearance signifying that all normal operation, maintenance and repair can be carried out without hazard provided the safety precautions specified in reference (c) are observed in handling contaminated material. The Bureau of Ships and Bureau of Medicine and Surgery will jointly grant final radiological clearance indicating that no further radiological hazard of any type exists on the ship and that further monitoring of radiological safety precautions are not required.

6. Detailed instructions to monitors will be promulgated by separate correspondence.

V. H. RADSDALE,
Deputy

/s/
L. J. BROUSSARD
Flag Secretary

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SNC WNDE V WNG NR C 119 P

FROM: BUMED 222127Z
FOR ACTION COMMANDER WESTERN SEA FRONTIER/SNC

INFO BUSHIPS/WNDE

RESTRICTED

COMPLETE BUMED BUSHIPS INSTRUCTIONS INCLUDING TOLERANCES IN MAIL TODAY X LATTER BASED ON MEDICAL ADVISORY BOARD RECOMMENDATIONS X IMPRACTICABLE TO HAVE TWO FORMS OF FINAL CLEARANCE BASED ON WHETHER ACTIVE SHIPS OR INACTIVE DISPOSAL SHIPS X OPERATIONAL CLEARANCE ONLY WILL BE GRANTED TO A SHIP UNTIL SUCH TIME AS FINAL CLEARANCE STANDARDS APPLICABLE ALL SHIPS CAN BE MET X THESE INSTRUCTIONS AND PROCEDURES FIRM

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Note: This directive supersedes CJTF-1 Serial 079 of 9 September 1946. (See Appendix II) and Joint BuShips-BuMed Serial 1381 of 24 September 1946 (Appendix IV).

BUSHIPS Code 180-A
All/Crossroads/C-S(99)-(0)

NAVY DEPARTMENT
BUREAU OF SHIPS
and
BUREAU OF MEDICINE AND SURGERY

[redacted]

22 November 1946

From: BuShips - BuMed.
To : Distribution List.

Subject: Radiological Clearance and Decontamination Procedures for Crossroads Non-target Vessels.

References:
(a) CWSF Conf. Ltr. P2-4 (WSF-07-bn) Serial 0564 of 11/18/46.
(b) CNO Conf. ltr. Op-602/cm ser 021 P602(SC) S67-1 of 27 August 1946.
(c) CJTF-1 Conf. ltr. ser 079 of 9 Sept. 1946.
(d) BuShips-BuMed Conf. Spdltr ser 1381 of 24 Sept. 1946.
(e) BuShips Conf. spdltr ser 1383 of 26 Sept. 1946.
(f) BuShips-BuMed Conf. disp 141550Z of October.
(g) BuShips-BuMed Conf. spdltr All/Crossroads/S99-2 of 6 Nov. 1946.

Enclosures:
(A) General Radiological Safety Precautions.
(B) Radiological Decontamination Procedures.

1. The operating portion of Joint Task Force One included a large number of non-target vessels. Many of these vessels entered Bikini Lagoon subsequent to Test Baker, and at a time when radioactive materials were suspended in the waters in low concentrations. Some of this material contaminated most portions of the vessels exposed to the water of the lagoon. Thus evaporators, condensers, salt water cooling systems with their heat exchangers, fire and flushing

systems, under water bodies of hulls, and fittings and equipage in contact with the sea water were contaminated in varying degrees when used in the lagoon after Test Baker. The radioactive material was found to be concentrated principally in marine growth, rust and salt scale deposits on the affected surfaces. The quantities of radioactive materials present were, in general, found to be in proportion to the quantities of fouling, scale, and rust present on the exposed surfaces and to the length of time during which they were in contact with the contaminated water.

2. All of the ships involved (target vessels not included) have low radiation intensities and small amounts of contaminating materials. They present no danger from external radiation. Any danger to personnel which may exist involves the introduction of contaminating toxic materials into the body. This can occur in any one of three ways, namely: (a) by the inhalation of contaminated dust or inhalation of fumes or vapors from heating contaminated materials; (b) by way of the mouth from contaminated hands or through ingestion of water or food which is contaminated; or (c) by absorption of contaminated material through cuts or wounds. Considering the relatively small quantities of toxic material present in any one ship and the great amount of gross material with which it is mixed (marine growth, scale, rust) and the quantities of this gross material necessary to gain access to the body in order to produce physical injury due to radioactive effects it is NOT LIKELY that personnel engaged in routine operations or maintenance of these vessels will suffer injury. It is CERTAIN they will not suffer injury if the precautions directed are followed, and the established clearance procedures complied with. The Bureau of Medicine and Surgery has established certain tolerance limits on the basis of recommendations made by an advisory board of experts in this field of toxicology. These are in conformity with nationally accepted standards for safety in regard to external radiation and to radioactive hazards within the body. For reasons of absolute safety and to insure that no form of radiological hazard may arise subsequently regardless of the ultimate disposal of the ships, clearances will be granted only in accordance with these standards.

3. Reference (a) established a radiological monitoring and clearance organization to determine the extent of radioactive contamination existing on any Crossroads vessel in the West Coast or Peral Harbor area. The monitoring results disclose what portions

of the vessel require decontamination to reduce the radioactive materials to a level at which they could never give rise to a question of hazard. Reference (b) assigns the Bureau of Medicine and Surgery cognizance and responsibility for the establishment of radiological safety tolerances and regulations. Reference (b) also charges the Bureau of Ships with responsibility for developing methods and equipment for radiological decontamination of ships.

4. Enclosure (A) is a compilation of all general radiological safety precautions to be observed in handling contaminated materials and in carrying out decontamination procedures. Enclosure (B) contains all currently approved decontamination measures to be used in obtaining Operational Clearance, and Final Radiological Clearance, and supersedes references (c) to (g) inclusive. Include as much of this as possible in "at sea" work.

5. Clearances are defined as follows:

(1) <u>Operational Clearance</u> indicates that all normal operations, repairs and maintenance can be carried out without radiological hazard provided the precautions set forth in Enclosure (A) for handling contaminated materials are observed. This is the clearance required for the normal operation of active ships.

(2) <u>Final Clearance</u> indicates that no radiological hazard of any type, no matter how remote, exists on the ship and that further monitoring is not required. It will apply in like manner to operating ships and to ships destined for inactivation or disposal. Before final clearnace can be granted the monitors reports and recommendations for such clearance must be forwarded to Chief of the Bureau of Medicine and Surgery and the Chief of the Bureau of Ships, one complete set of reports to each Bureau. Inasmuch as this is the clearance required of all ships prior to inactivation or disposal, it is desirable that all ships satisfy the requirements for final clearance as early as practicable.

6. Clearances are granted as follows:

(1) <u>Operational Clearance</u> is granted by the Commander, Western Sea Frontier on recommendation of CWSF ship Clearance

Board in accordance with safety tolerances and practices established by BuMed and in accordance with the procedures for clearance, monitoring and reporting established jointly by BuShips - BuMed.

(2) Final Clearance is granted by BuShips with the advice and concurrence of BuMed after review of the complete and final monitoring report for the individual ship.

7. The criteria for clearance are:

(1) The existence of any areas of radioactivity with readings in excess of 0.1r gamma or 0.5r gamma beta combined is considered as above safety tolerance for external radiation and will be immediately decontaminated or disposed of, and there will be taken such other precautions as are required to insure safety of personnel. Serious radioactive hazard, not involving external radiation, will exist in enclosed salt water systems which give a reading of 0.1r gamma through the metal of the system. All areas of contamination within closed salt water systems with readings between 0.1 and 0.01 gamma on external reading will be decontaminated immediately.

(2) Operational Clearance MAY be granted for urgent reasons when readings are:

(a) Maximum, shielded, between 0.1 and 0.001r gamma.

(b) Maximum, unshielded, between 0.5 and 0.005r beta gamma combined except underwater bodies with surface readings having statistical averages between 0.5 and 0.02 beta gamma combined.

Operational Clearance WILL be granted when readings are:

(a) Maximum, shielded, between 0.01 and 0.001r gamma.

(b) Maximum, unshielded, between 0.05 and 0.005r gamma beta combined except hulls of ships external surface readings having statistical averages between 0.05 and 0.02 beta gamma combined.

(3) Final Clearance will be granted when readings are:

(a) Maximum, shielded, not above 0.001r gamma.
(b) Maximum, unshielded, not above 0.005 gamma beta combined.

Exception (a) Underwater body, readings statistically

[redacted]

averaged not above 0.02r beta gamma combined and with no single localized area in excess of 0.1r beta gamma combined.

Exception (b) salt water systems having external readings ninety-four (94) per cent of which are not above 0.001r gamma, five (5) per cent not above 0.005r gamma and, one (1) per cent not above 0.01r gamma.

8. Responsible individuals expedite final clearances by seeing that necessary cleaning is done to bring contaminated areas within the final clearance levels prior to submitting reports with requests for final clearance.

9. Drydocking for radiological purposes will not be required when the following conditions exist: Exterior underwater surfaces (including sea water intakes and overboard discharges from the opening in the hull to the first valve) have averaged statistical readings less than 0.02r combined beta and gamma with no localized area above 0.1r beta gamma. Docking will be referred to the Bureau of Ships for decisions.

10. All radiation intensity readings will be corrected to 1 October 1946 for purposes of assossing radiological hazards and granting clearance. No differentiation will be made between wet and dry conditions of surfaces in applying the standards set forth above, all readings are in roentgens per 24 hours (r/day).

ROSS T MC INTIRE,
Vice-Admiral, USN.
Chief of Bureau of
Medicine and Surgery.

[redacted]

EARL W MILLS,
Vice-Admiral, USN.
Chief of Bureau of Ships.

GENERAL RADIOLOGICAL SAFETY PRECAUTIONS CROSSROADS VESSELS

1. All non-target vessels which entered Bikini Lagoon after the Atomic bomb tests are more or less contaminated by radioactive materials which were picked up from the water in the lagoon. The parts of the ships which were in contact with sea water are the principal areas which are affected, namely:

(a) The underwater body of the ship and appendages.
(b) The interior of the fire and flushing systems.
(c) The salt water sides of condensers, heat exchangers, salt water pumps and associated salt water piping used while in the lagoon.
(d) The interior of the evaporators and associated salt water piping.
(e) The exterior hull and salt water cooling systems of small boats.
(f) Anchors, anchor chain and chain locker.
(g) Lines, fenders and similar equipage used at Bikini, also stowages for these items and for small boats.

The majority of the above areas no longer have sufficient hazard from external radiation to be of concern. The potential danger involved at the present time is that of an individual being poisoned by the radioactive materials which are present. The only way the latter action can be dangerous is by an individual eating, breathing, or getting into an open cut or a skin abrasion a sufficient quantity of this radioactive material.

2. The safety precautions which are enumerated herein are designed to prevent any possibility of hazard due to radioactive toxicity.

(a) At the earliest possible date obtain a complete monitoring in order to know specifically the location and relative quantity of radioactive materials present. Until a suspect unit has been pronounced clear by a monitor it should be regarded as contaminated.

(b) As soon as practicable thereafter proceed with the authorized decontamination measures for the fouled locations. When these are completed request remonitoring to ascertain if they have been completely effective.

(c) If it is necessary to open up a contaminated system the following precautions should be observed:

(1) Keep wet until found clear of contamination all surfaces which have been exposed to salt water. This will effectively prevent extensive amounts of dust forming.

(2) If it is necessary to perform any work on a contaminated unit, clean the part thoroughly before working on it. Remove all rust scale, marine growth, and sediment while wet.

(3) Skin contact with radioactive materials shall be avoided. For this reason, gloves should be worn when working on a contaminated part or in handling materials which have been removed from contaminated surfaces. When working on a large contaminated surface with the body comes in contact, such as manual cleaning of the inside of a main condenser or when removing contamination from the underwater body of the ship, long sleeved work clothing, gloves and caps should be worn. Under these circumstances the clothing worn during the work should be laundered daily or on completion of the job. When sandblasting of the underwater body in drydock is required for decontamination, the clothing ordinarily worn in this operation is satisfactory, but should be laundered on completion of the work. During drydock work on contaminated ships, rubber boots should be worn and thoroughly hosed off after completing the work.

(4) Observe scrupulous cleanliness in the removal of radioactive materials. Every effort should be made to prevent spreading such materials. They must be kept wet and placed in a closed container for disposal by sinking at sea th the first available opportunity.

(5) Tools and equipage used in removal of contaminated materials should be thoroughly cleaned upon completion of work. Rags, fiber brushes, brooms, etc., should be washed upon completion of use or disposed of with the contaminated materials.

(6) Where welding, brazing, or flame cutting of contaminated piping or surfaces is accomplished adequate exhaust ventilation must be assured.

(7) All solutions used in decontamination have the ordinary industrial hazards and, in addition, when they have been circulated in a suspect system are a radioactive hazard. Used solutions should be disposed of at least 10 miles at sea or beyond the 100 fathom curve.

(8) Where decontamination of the underwater body of the ship is required, all rust and marine growth removed in drydock shall be handled in accordance with instructions in subparagraph (4) above. If wet sandblasting is required for decontamination, the sand should be gathered up and prepared for sinking at sea.

(9) Contaminated piping, valves, and other units which are removed for replacement before decontamination shall be segregated and disposed of at sea.

(10) Loose contaminated materials which are awaiting disposal should be segregated and labeled to prevent unwitting use or meddling. Open sources of radioactive debris should not be left untended. If necessary to leave a contaminated unit open for a period of time it should be covered temporarily when no work is in progress.

RADIOLOGICAL DECONTAMINATION PROCEDURES

1. When exterior radiation readings above approved tolerance levels are obtained on radiologically suspect parts of non-target crossroads vessels, all ships should carry out the decontamination procedures specified herein for the parts affected. This work should be accomplished at the earliest practicable date without interfering with the operating schedule. Attention is directed to the safety precautions outlined in Enclosure (A); all applicable portions must be observed while conducting the decontamination procedure. The principal decontamination agent used is a muriatic acid base with other materials added as noted in the procedure for each unit. Several general industrial safety precautions which must be used in handling the acid are noted:

(a) Mix the acid in open air if possible.

(b) Pour the acid into the water slowly, never the water into the acid.

(c) Personnel engaged in handling and mixing acid should wear rubber gloves, splash proof goggles, and acid fume respirators. Bicarbonate of soda solution should be available as a neutralizer in event of spilling or splashing acid on personnel. Soda ash or [illegible] compound should be available for neutralizing that spilled on the [illegible].

(d) When large units such as evaporators and condensers are [illegible] some quantities of hydrogen gas may be given off. If practicable they should be vented to the outside atmosphere. In any event no [illegible] or [illegible] devices should be permitted in the immediate vicinity [illegible] or vent.

(e) [illegible] NOT heat the acid solution.

(f) [illegible] connections, many of which may be temporary, made for the purpose of circulating the acid solution shall be tested with [illegible] water before actual operation.

(g) While the acid solution is circulating, a continuous [illegible] shall be maintained on all parts of the system for the purpose of promptly detecting any leaks which may develop and applying [illegible] measures.

(h) All valves which are closed to prevent entry of acid solution into a part of the system in which it is not desired to circulate the acid should be tagged and wired or tied shut.

[redacted] ENCLOSURE (B)

2. The procedures given below are the approved radiological decontamination methods for each unit and system which has been found to contain radioactive materials:

A. EVAPORATORS. (Except Badger types having AA or AAA type heat exchangers).

(1) Evaporators should be given one or more thermal shock treatments to break loose as much scale as possible.

(2) All loose scale and any zincs in heat exchangers should be removed and prepared for disposition.

(3) The distilling plant is to be set up to provide for acid circulation through the entire salt water system, i.e. shells, salt water and brine piping, pumps and heat exchangers. This involves:

(a) Positive prevention of the acid solution getting into the fresh water side of the system shall be accomplished by removal of necessary lines and blanking off the ends.

(b) An acid mixing tank should be provided; an ordinary steel tank will suffice. It is desirable that the tank be large enough to mix a sufficient quantity of solution to fill the system, although several mixes may be used to fill the system.

(c) A filling line shall be run from the acid tank to the suction side of the pump selected to circulate the acid through the system. A line or lines should be run from the brine discharge or other appropriate drain lines back to the acid mixing tank. Rubber lined firehose may be used for the temporary lines.

(4) The acid solution should be mixed by adding two parts 18° Baume commercial muriatic acid to 15 parts fresh water. Where salt water or brine lines are steel or galvanized wrought iron pipes an inhibiter (Rodene-Navy Spec. 51-I-2a) shall be added in the proportion one part inhibiter to 100 parts of the commercial acid added.

(5) Fill the system completely. The shells must be vented as near the top as possible in order to accomplish complete filling of the shell. When the acid solution enters the shells considerable foaming will occur and may come out the vents. Buckets should be placed to catch all overflow.

(6) The acid shall then be continuously recirculated until all scale in the shell and tube nests is dissolved. This may be detected visually. The normality of the acid should be checked during the operation and not allowed to fall below one normal. Where scale is unusually heavy it may be necessary to add additional acid to complete the process. The circulation should in any case by for at least two (2) hours. but not over four (4).

(7) Upon completion of circulation drain the system completely to remove all acid. Drain all pockets, particularly the lines which were blanked off (drains from baffle pan and vapor line). Flush the system thoroughly by circulating fresh water and pumping overboard. Flush baffles particularly, and remainder of inside of shell thoroughly by firehose through the sight ports and redrain. The acid removed should be handled as a contaminated material.

(8) The system shall then be flushed out with a boiler compound solution to neutralize any residual acidity.

(9) The plant may then be reassembled, replacing any zincs which were removed, and placed in operation. If a monitor is available it is desirable to check the sufficiency of the treatment before proceeding to break down the acid circulating system and reassemble the plant. All distilled fresh water manufactured in the first twenty-four (24) hours after placing the plant back in operation shall be dumped overboard.

(10) Upon remonitoring it may be found that certain parts are extensive a complete reapplication of the procedure may be necessary. Generally if all scale is removed from the shell and tube nest it will be found easier and more effective to disassemble the unit above tolerance and clean, either manually or by separate acid washing. All parts which occasionally have been found to require separate treatment are cited:

(a) At least one set of baffles at the top of first effect shell.

(b) Distiller condenser heads.

(c) Brine overboard discharge line at elbows and valves.

(d) Some parts of brine overboard pump where acid circulation was incomplete or ineffective.

(e) Strainers on the suction side of the salt water pump.

ENCLOSURE (B)

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A-1. Badger type evaporators having Double A or Triple A heat exchangers shall be boiled out for 96 hours at a temperature of 200° Fahrenheit using one pound of boiler compound to ten gallons of water. Associated salt water piping should be cleaned as specified for the fire and flushing systems.

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B. SALT WATER SYSTEMS

The following steps shall be used in cleaning those portions of the salt water systems which monitoring reveals to be so contaminated as to exceed established tolerance levels. The salt water systems involved include fire and flushing systems, salt water sides of cooling systems with associated heat exchangers except condensers, pumps, and drainage piping associated with these systems. Parts of systems showing acceptable monitor readings should be excluded from the cleaning process of they can be isolated.

(1) Place a large mixing tank on deck in a suitable location to run a hose or piping to the suction side of a pump serving the system to be treated. Arrange the suction of the pump, if possible, to allow taking suction on the mixing tank, salt water or on air alternately. Provide recirculating connections by hose from parts of the system most remote from the pump and lead back to discharge into the mixing tank.

(2) Fill special mixing tank with solution of one gallon 18° Baume commercial muriatic acid to ten gallons fresh water and two ounces inhibiter (Rodene-Navy Spec. 51-I-2a) if available.

(3) Drain systems to be cleaned as completely as possible using drain connections on pumps and as available at low points of systems. Open outlets or vents in systems to permit air to enter for effecting complete drainage. Water thus drained may be pumped overboard in the harbor or at sea.

(4) Fill system with acid solution from mixing tank introducing through pumps selected. The systems should be filled completely with the solution which will probably involve the preparation of several mixes. Outlets on the system are to be opened until it is determined by flow that the decontamination solution has reached all parts of the system. As each line is filled, the associated outlet is closed until all parts are filled and all outlets closed.

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(5) After the system has been filled completely, recirculate the acid solution using the pump and the recirculating lines provided back to the mixing tank. This process should be continued for about four (4) hours. During this period the normality of the acid should be checked by sampling the acid added as needed to maintain at least 1/2 normal strength.

(6) Upon completion of decontamination circulation, if the ship is in dock, drain acid solution from system as completely as possible using drains provided and collect solution in suitable containers for disposal as prescribed for contaminated materials. If the vessel is at sea, discharge the solution overboard upon completion of circulation using drains found to be contaminated. For vessels in harbors or alongside piers, the acid solution shall be drained into containers provided. Drain lines outboard of sea valves are considered as parts of the hull and shall be treated with the underwater boxy as required at first drydocking.

(7) After draining acid solution, flush the entire system thoroughly with salt water for at least one hour using all available outlets for discharge. For ships not at sea this water may be pumped into harbors.

(8) After the salt water flushing, prepare a neutralizing solution in the special mixing tank using 50 pounds of boiler compound to 1,000 gallons of water. Drain the system and fill with the neutralizing solution using the same process as for the decontaminating solution. Recirculate the neutralizing solution for at least thirty minutes.

(9) As a final step in the process, shift the pump back to sea suction and flush the entire system thoroughly with salt water using each outlet for thirty minutes.

(10) Remonitoring after decontamination may reveal that the system has not been entirely reduced to tolerance limits. In such cases, the troublesome areas generally will be found in pockets

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in the system such as large valves, at reducer stations or in stagnant sections of lines. When such cases occur, the parts remaining above tolerance should be removed if practicable and any remaining collection of scale, silt or fouling removed manually. The part should then be given an acid dip in a one normal solution of muriatic acid and fresh water for about ten minutes to remove any residue and then thoroughly neutralized and rinsed. When large parts of systems or a whole system remain above tolerance after applying the above methods, the system shall be given a second acid treatment as set forth above. If the system then fails to respond, the Bureau of Ships shall be advised of the conditions and necessary instructions requested.

C. CONDENSERS EXCEPT MAIN CONDENSERS.

Salt water sides of all condensers except main condensers which show readings above acceptable limits shall be treated as follows:

(1) Completely drain condenser and remove zincs. Place zincs aside for disposal as required for contaminated materials removed.

(2) Set up mixing tank in convenient location on deck equipped with hose to lead to condenser for filling with solution by gravity.

(3) Fill mixing tank with solution of one gallon 18° Baume commercial muriatic acid to twenty gallons of fresh water, and two ounces of inhibiter (Rodene-Navy Spec. 51-I-2a).

(4) Fill condenser and associated piping with solution preparing additional mixes as necessary to fill completely. Insure complete filling by leaving vents open to release air and to check when full by flow from vents. Place containers at vents to collect solution which will escape from boiling action of acid.

(5) Circulate solution through condenser if possible for one hour, otherwise allow to stand in condenser for one hour. If in

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harbor drain off solution and dispose of as required for contaminated materials removed. If at sea, discharge solution overboard through regular overboard lines.

(6) Flush entire system completely for one hour using salt water and discharging overboard.

(7) Using mixing tank provided, fill condenser with neutralizing solution of fifty pounds boiler compound to 1,000 gallons of water. Circulate if possible or allow this solution to stand in condenser for at least thirty minutes. Then reflush thoroughly using salt water and discharge overboard.

(8) Remonitor condenser. If readings are still above tolerance levels, remove all necessary inspection plates and determine location of remaining contamination. If heads are contaminated remove scale and fouling from surfaces manually and brush with one normal acid mixture until readings have reached tolerance level. If tubes show contamination remaining, punch tubes using rod and wet rag to remove material adhering to surface. Follow this by lancing thoroughly with water. Collect and dispose of all removed material as required by Radiological Safety Precautions (Enclosure (A)).

(9) Make complete inspection of condenser to locate and repair any damage which may have been caused in the process with special attention to tube ends which are packed. Put air test on condenser and remedy any leaks.

D. MAIN CONDENSERS.

Main condensers which show monitor readings above final clearance limits should be treated in accordance with the following procedure:

(1) Drain condenser and remove zincs. Set zincs aside for disposal in accordance with procedures set forth for disposing of contaminated materials by Radiological Safety Precautions.

(2) Remove all scale, rust and marine growth from inside of con-

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denser heads by scrapers and wire brushes keeping the surface wet at all times. If radioactive materials are still present in measurable quantities, scrub condenser heads and salt water sides of tube sheets with ordinary scrub brush and a solution of one gallon of 18° Baume commercial muriatic acid to ten gallons of fresh water and two ounces of inhibiter (Rodene-Navy Specs. 51-I-2a) if available. Flush off surfaces thoroughly with salt water to remove acid.

(3) If tubes show readings above final clearance limits, punch tubes with a rod and wet rag to remove material adhering to surface and wash out with a water lance.

(4) Collect and dispose of all loose material removed in accordance with instructions for handling contaminated materials in Radiological Safety Precautions.

(5) On completion of above work flush condenser thoroughly with salt water discharging overboard for at least one hour.

(6) Remonitor, and if readings are still above limits, repeat the process.

E. UNDERWATER BODY.

The necessity for drydocking ships for decontamination purposes generally will be determined by listing and trimming the suspect vessels as much as practicable by shifting liquids and monitoring portions of underwater bodies thus exposed. Readings of at least ten representative areas on each side of the exposed underwater body will be taken with readings spaced as evenly as practicable. The average of these readings on each side will be considered as representative of the general radiological condition of the underwater body. If the average of the readings so obtained is .020 or less roentgens/day combined beta and gamma corrected to 1 October 1946, the underwater body will be considered as meeting the requirements for final clearance and no further precautions are required. On vessels being drydocked for other reasons, the underwater body will systematically monitored in drydock as outlined in the standard monitor forms. The average intensity of radiation on the under-

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water body so determined will then be used in the same manner as when listing the ship to determine whether decontamination is required. When the average underwater body readings as specified above is found to be above .020 roentgens/day, the underwater body will require decontamination in drydock and the following procedure shall be followed:

(1) Remove marine growth using long handled scrapers. During this operation the sides of the ship and the drydock floor shall be kept wet at all times to prevent the formation of dust. Upon completion of scraping, the sides and the bottom of the ship shall be hosed down vigorously using salt water at high pressure. Materials removed shall be gathered up and disposed of as prescribed for contaminated materials in the Radiological Safety Precautions (Enclosure (A)).

(2) Remonitor the underwater body to obtain the new statistical average of radiation intensity. If the hull then meets the established tolerance limits no further radiological precautions are necessary and normal work may proceed.

(3) If remonitoring after scraping and hosing reveals that established tolerance levels have not yet been met, the underwater body must be wet sandblasted for decontamination purposes. The standard wet sandblasting procedure is satisfactory for this purpose and will remove the radioactive material. Upon completion of the sandblasting, the topside, sides and bottom of the ship and the sides of the dock shall be washed down to collect all sand in the bottom of the dock and the ship remonitored. The sand shall then be collected and disposed of as required for contaminated materials removed by Radiological Safety Precautions (Enclosure (A)). After removal of the sand, the drydock floor shall be washed down vigorously and the water pumped into the harbor.

F. <u>SHIPS BOATS.</u>

The ship's boats which were used in the lagoon in many cases picked up an amount of radioactivity on the exterior hulls and in the

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engine cooling systems.

(a) Wood hull boats when found to be above tolerance are to be decontaminated by removing the bottom paint by use of a strong solution of lye and boiler compound. This solution will soften the paint after being applied generously and being allowed to stand for about a half hour. The paint may then be scraped off. The scrapings should be treated as contaminated materials and the Safety Precautions given in enclosure (A) observed in their removal and handling. The underwater body should then be washed thoroughly to remove all lye and boiler compound and remonitored if a monitor is available. The boat should then be repainted in accordance with painting instructions when pronounced clear. Boats fitted with steel rubbing strips on the keels may retain some quantity of radioactive material under the strips where they are rusted or where the wood is partially rotted. In these cases the rubbing strips should be removed, rust cleared off, rotted wood removed, if practicable, and rubbing strip replaced.

(b) Steel hull boats, if readings are above tolerance, should be treated as the underwater body of the ship given in (E) above.

(c) Engine cooling systems and tailpipes found to be radioactive shall be treated as specified for the salt water piping by (B) above.

(d) Boat propellers found to be contaminated shall be scraped and then washed with an acid mixture as prepared for the salt water piping.

G. <u>HULL, HULL FITTINGS AND DECK EQUIPMENT.</u>

Exposed areas of the ship's hull (other than the underwater body), hull fittings, ground tackle and other deck equipment found to have radiation readings in excess of final clearance limits shall be treated as follows:

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(1) Exposed surfaces of the hull or hull fittings, if painted, shall be scrubbed thoroughly with a strong solution of lye and boiler compound using long-handled scrubbers and scraped to remove as much of paint as possible in the process. The lye and boiler compound solution should be made up of about 4 1/2 pounds of lye and 5 pounds of boiler compound to 10 gallons of fresh water. Unpainted or rusty surfaces shall be scrubbed in a similar manner using a solution of one gallon 18° Baume commercial muriatic acid to 10 gallons of fresh water and two ounces of inhibiter (Rodene-Navy Specs. 51-I-2a) if available. Upon completion of scrubbing each area of one or two square yards, hose down vigorously affected parts and decks in the vicinity with salt water to remove all of the solution.

(2) Anchor chain and anchors if above final limits shall be sandblasted at the first opportunity. To decontaminate chain lockers which exceed final limits, gather up all loose scale and rust keepint it wet at all times and dispose of in accordance with instructions for contaminated materials in Radiological Safety Precautions. Then hose down decks, bulkheads and overheads vigorously with salt water and pump overboard.

(3) Miscellaneous deck equipment made of fibrous vegetable material such as lines, fenders, brooms, swabs, scrubbers and the like are not susceptible to any known method of decontamination at this time. If any of these items exceed final clearance limits they should be segregated and disposed of as specified for contaminated materials removed in Radiological Safety Precautions.

(4) Deck equipment such as internal combustion engine driven pumps having salt water cooling systems shall be treated by circulating acid solution as prescribed for salt water systems and heat exchangers in section (B) above.

(5) If after the above treatment any of the affected parts show readings still above final clearance limits, the processes shall be repeated until limits are met.

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[redacted]

DRAFTED: FEE/Payne

FROM: BUSHIPS

27 NOV 1946

TO: RADSAFE NAVSHIPYD SAN FRAN

INFO: COMWESSEAFRON
GUNSTON HALL (LSD5)
CNB TERMINAL ISLAND

272307Z

BALLAST TANKS AND CONNECTING PIPING IN L S DOGS REUR 251805Z ARE TO BE CONSIDERED AS PART OF UNDERWATER BODY FOR GRANTING RADIOLOGICAL CLEARANCE X BALLAST PUMPS AND PIPING IN COMPARTMENTS OTHER THAN TANKS TO BE CONSIDERED SAME AS OTHER SALT WATER SYSTEMS FOR CLEARANCE X BUMED CONCURS X

272307Z

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DRAFTER: FEE/FISHER
FROM: BUSHIPS
RELEASED: T. A. SOLBERG
4 DECEMBER 1946

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ON BASIS FURTHER STUDY RADIOLOGICAL HAZARDS AND CONFERENCES WITH BUMED, MANHATTAN DISTRICT, RADIOLOGICAL SAFETY ADVISOR AND UNIVCAL REPRESENTATIVES FOLLOWING DECISIONS MADE. NO HEALTH OR SECURITY HAZARDS ARE PRESENT IN FOLLOWING PROCEDURES. THESE INSTRUCTIONS SUPERSEDE PREVIOUS RESTRICTIONS IMPOSED AND WILL BE INCORPORATED IN CHANGE TO MY CONF LTR ALL/ALL CROSSROADS /C S(99) (0) OF 22 NOVEMBER 1946: A. SPECIAL DISPOSAL OF SAND USED IN WET SANDBLASTING UNDERWATER BODIES CROSSROADS NON TARGET VESSELS NOT REQUIRED. B. MARINE GROWTH AND SCALE REMOVED FROM VESSELS AT FIRST DRYDOCKING SHALL BE SEGREGATED AND SUNK AT SEA AS PREVIOUSLY PRESCRIBED. C. ACID AND OTHER DECONTAMINATING SOLUTIONS USED IN CLEARING SALT WATER SYSTEMS MAY BE DISCHARGED INTO HARBORS. SOLUTIONS SHOULD BE DISCHARGED AT SLOW RATE OR BY PROVIDING A FLOW OF WATER ALONG WITH DISCHARGE SO AS TO DILUTE THE SOLUTION ABOUT ONE FOURTH. DISCHARGE SHOULD BE MADE WELL CLEAR OF DOCKS AND SHORE LINE DURING EBB TIDE. D. SCALES AND MARINE GROWTHS REMOVED MANUALLY FROM EVAPORATORS AND SALT WATER SYSTEMS SHALL BE SEGREGATED AND SUNK AT SEA AS HERETOFORE. E. ALL PROCEDURES SHOULD BE TREATED AS ROUTINE IN ORDER TO MINIMIZE ANY ADVERSE PUBLICITY. BUMED CONCURS.

[redacted]

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BUSHIPS CODE 180-A
S(99)-(0)(180-A)

NAVY DEPARTMENT
BUREAU OF SHIPS
and
BUREAU OF MEDICINE AND SURGERY
WASHINGTON 25, D.C.

BUMED/GML/df
Serial: 0584 (SC)

[redacted]

17 December 1946

To: DISTRUBUTION LIST.

Subj: Radiological Clearance and Decontamination Procedures for CROSSROADS Non-target Vessels.

Ref: (a) BuShips-BuMed Conf. ltr of same subject All/Crossroads/ C-S(99)-(0) dated 22 Nov 1946.

1. Reference (a) outlined the procedure for granting radiological clearance to Bikini non-target vessels and contained, as enclosures, general radiological safety precautions and radiological decontamination procedures.

2. Subsequent investigation has revealed that certain requirements with respect to tolerances, disposal of sandblasting sand and discharge of used decontamination solutions can be relaxed.

3. The following changes have therefore been affected in the requirements and procedures specified by reference (a). It is requested that changes be made immediately by all holders of the reference.

> (a) Page 4, subparagraph 7(3), change Exception (a) to read as follows: "Underwater body, at least twenty readings as equally spaced as practicable, ten on each side, statistically averaged do not exceed 0.02r beta gamma combined with no single localized area in excess of 0.1r beta gamma combined. For clearance purposes, the underwater body will be considered to include all salt water injections and overboards to the first sea valve. The same criteria as specified for clearance of underwater bodies will apply to anchors, anchor chain, chain lockers, and underwater bodies of small boats."

[redacted]

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BUSHIPS S(99)-(0)(180-A) 12/17/46 BUMED SER: 0584(SC)

[redacted]

(b) Page 4, subparagraph 7(3), change Exception (b) to read as follows: "Salt water systems when ninety-four (94) per cent of the total areas exposed to sea water in the systems have external readings not above 0.001r gamma, five (5) per cent not above 0.005r gamma, and one (1) per cent not above 0.01r gamma.

(c) Enclosure (A), subparagraph 2(c)(7), change to read as follows: "(7) All solutions used in decontamination have the ordinary industrial hazards. Used solutions may be dumped at sea, preferably through contaminated outlets or overboard discharges, or in harbors for ships in port or in drydock. When used solutions are discharged into harbors, the process should be carried out at a slow rate and a flow of water provided to dilute the decontaminating solution about four to one. The solution should also be discharged well clear of docks and shoreline, and at the commencement of an ebb tide if possible."

(d) Enclosure (A), subparagraph 2(c) (8), change to read as follows: "When decontamination of the underwater body of the ship is required, all rust and marine growth removed in dock shall be handled in accordance with instructions in subparagraph (4) above. If wet sand blasting is required for decontamination or is accomplished, no special handling or disposal of sand for radiological purposes is required. In cases where a ship requires underwater body decontamination in drydock and sandblasting is accomplished without preliminary scrapting of the fouling and marine growth, the mixture of sand and marine groth removed must be gathered up and disposed of in accordance with instructions in sub-paragraph (4) above."

(e) Enclosure (B), page 2, subparagraph 2A(7), delete last sentence reading "The acid removed should be handled as a contaminated material".

[redacted]

BUSHIPS S(99)-(0)(180-A) 12/17/46 BUMED SER: 0584(SC)

[redacted]

(f) Enclosure (B), page 4, subparagraph 2B(1), change second sentence to read as follows: "Arrange the suction of the pump, if practicable, to take suction on the mixing tank for the acid treatment and subsequent neutralization, and on salt water for the dumping and flushing".

(g) Enclosure (B), page 4, subparagraph 2B(6), delete entire subparagraph and substitute the following: "Upon completion of decontamination circulation, discharge the solution overboard using drains found to be contaminated. If the discharge is made into a harbor, it shall be accomplished as specified in Enclosure (A), subparagraph 2(7). For clearance purposes, all salt water lines and parts of systems outboard of sea valves are considered as parts of the hull and shall be treated with the underwater body as required at first drydocking."

(h) Enclosure (B), page 6, subparagraph 2C(5), delete second and third sentences and substitute the following: "On completion of acid treatment, discharge solution overboard through regular overboard lines, following precautions set forth in enclosure (A), subparagraph 2(7), if in a harbor."

(i) Enclosure (B), page 8, subparagraph 2E(3), delete fourth sentence starting "The sand shall then be collected ...." and substitute the following: "If the underwater body requires decontamination and sandblasting is undertaken without scraping as outlined in subparagraph (1) above, the sand shall be collected and disposed of as required for contaminated materials removed as specified by Radiological Safety Precautions (Encl. (A))."

T.A. SOLBERG
By direction
Chief of Bureau of Ships

C.A. SWANSON
Chief of Bureau of
Medicine and Surgery

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APPENDIX V

MISCELLANEOUS
CONFERENCE NOTES

[redacted]

COPY

FROM: COMWESSEAFRON

ACTION: BUSHIPS
BUMED

DATE 28 SEPTEMBER 1946

280110Z

ATTENTION BUSHIPS CODE 180.

AS RESULT CONFERENCE, DOCTOR HAMILTON BERKELEY 27TH RECOMMEND FOLLOWING REVISION PARAGRAPH "H" YOUR SERIAL 1381. PIPING AND FOULING REMOVED SHOULD BE KEPT WET UNTIL DUMPED AT SEA. MATERIAL SHOULD NOT BE ALLOWED TO DRY. ALL SALT WATER PIPING HAVING READINGS .1 ROENTGEN OR OVER PER DAY SHOULD BE CLEANED WITH BUFFER SOLUTION. SAME FOR PIPING WITH READINGS LESS THAN .1 BUT GREATER THAN .01 IN MORE THAN 25% OF SYSTEM. WILL PROCEED ON ABOVE BASIS PENDING DECISION. FOR DISPOSAL AND INACTIVATION, SHIPS SALTWATER PIPING SHOULD BE CLEANED

BUSHIPS ....ACT

BUMED ....CJTF 1...414...

[redacted]

REPORT OF CONFERENCE

San Francisco Naval Shipyard

Meeting at 1100, 1 October 1946.

Present were: Dr. F. H. Rodenbaugh
Dr. K. G. Scott
Capt. W. E. Walsh (MC) USN
Capt. Wynn, USN
Capt. Lemler, USN
Capt. Maxwell, USN
Lt. Comdr. Turnbaugh, USN
Lt. Comdr. Skow, USN
Lt. Chadbourn (MC) USN
Lt. (jg) Morton (MC) USN
Lt. Howell, USNR
Mr. Hammond
Mr. Gordon
Comdr. Hoffman

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Maxwell: We called this conference together to make certain recommendations to BuShips on the means and methods to decontaminate salt water piping based on experiments conducted at this Yard - using amonium citrate solution and muriatic acid solution. We found that muriatic acid removes all the foreign matter and activity. It does a complete job. The ammonium citrate does a similar job to a lesser extent - about 90% of the activity is removed. We found a medicine that can be used - it may not be the best, etc.

Dr. Scott and Dr. Rodenbaugh, are you in a position to give us a few answers that we are after - when should we use this medicine - what standard should we use - when should we use the acid and when should we use the citrate thru the salt water system?

Rodenbaugh: You mean as to how much radiation you have in the systems? You may ask me from a medical point of view, but ask Dr. Scott about the physical aspects.

Maxwell: Dr. Scott?

Scott: You are putting me on the spot. I think before we get right down to this concrete problem as to when we should use this medicine, I am still trying to get clear what I had hoped an earlier conference would accomplish - that is to weld this large uncompletely connected unit into a little more tight organization so that we can function to the point where what the Lab in Berkeley has to offer can be more readily used by the Navy. I feel that even now we are not informed to the extent we should be in order to give you the maximum amount of advice that we could. I think someone, preferably someone who is a radio chemist, should be given more or less some type of directing authority so that we can coordinate on these various activities which are going on in about three different places. I recommend Mr. Morton, who is here now, for this position. He has had a lot of training in this field and is in the service. Experimental work of this nature should be under observation by a radio chemist so that we always get the maximum of information from it.

The other thing I think should be done is the type of thing Dr. Hamilton suggests - that is, we should repeat these findings that we have done on the underwater body

[redacted]

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and perhaps welding on salt water lines so that we are absolutely certain that we are right. One true experiment doesn't mean it is a fact. On the hull cleaning programs, what appears to be safe should be checked several times in order to be absolutely sure we are right.

With respect to the exact question - when should we decontaminate ships? I think everyone realizes that the radiation behind a pipe which gives you 1/10 R a day over a long length may eventually turn into a lethal dose of radiation. This might conceivably occur if you had a trans-location of radioactive matter so that it all collected in one spot. You may then unduly expose personnel getting into this spot. The question is, where can we set the limit? We can not say it 1/10 R a day. Dr. Hamilton thinks 1/100 R a day, which he seems to think is safe. He certainly would change his mind in view of other facts which he does not know at present. For instance, is there a normal trans-location of solid matter in pipe lines. I don't have a recommendation to give unless I can get more facts. I don't know if rust can move from one side to another, - I don't know the mass involved - or that we can actually get this activity in one pile. I would like to make quantitative measurements of the total radioactivity in a ship's system before setting any limit to which we should strive in decontamination. Then I think that someone like Dr. Rodenbaugh can tell us whether or not it is dangerous.

I think that so far the work has been considerably well controlled. Considering the different groups of people that have gotten together, we have done a very satisfactory job, but I do think perhaps BuShips and our group at Berkeley and someone in Captain Walsh's office should get together and more or less plan any large experiments which are done from beginning to end before the decisions are made so that we can have the benefit of the services of the three groups.

The other thing is a question of dissemination of information. I am never aware just what the monitors have done. I think we should have more system and some one person become the organizer of this thing so that the various groups can get full information when it is available.

Maxwell: You mentioned Dr. Morton?

Scott: He would be the logical choice to properly consider these problems and see the various sides of it since he is in the services. I would suggest him to be the go-between man. He is in a position to see everyone's side of the question. I do think you should have other people represented. You have people such as Turnbaugh and someone in the medical angle - these people could get together and in a very short conversation could decide whether or not something could be done. We don't have as much point to our meetings here as a group of 2 or 3 men. The Yard chemists should also get into this - he is doing the industrial chemistry.

Walsh: We could set up an organization now - get a group together - Morton, Chadbourn, Skow (representing me), Turnbaugh, Mr. Gordon.

Morton: In order to determine all these things, Dr. Scott has bought out, I feel that first of all the mutual interchange of information is the most important thing, and we all have to get together in getting this information. In other words, the monitors are going to help the Lab. at Berkeley, Berkeley help the Lab. here, etc. We want to find out whether or not a ship is a radiological hazard. To do so we have to have the monitorings. We want to see how it is monitored so that we can have some idea what is going on. Those parts that are hot tagged and we want to see that samples are taken for the Lab. Whoever happens to be the "leg" man should go along with the monitors and present his ideas and arrive at some idea as to the practical method to be used. That way, we can calculate the volume, size, location and total mass of debris. We can get together with the men in BuShips who know the possibility of translocation of the debris - actually what the possibilities of its accumulating in one place. We can get together with the medical men and together determine whether or not the ship should be decontaminated. Once that is determined - whether or not the ship is to be decontaminated - the Lab. again comes into the point of view in determining whether or not decontamination has actually been achieved.

Maxwell: Dr. Morton could assume responsibility of coordination between the Yard and the University, be under Lt. Commander Skow's supervision, insofar as monitoring of ships is concerned.

Morton: We don't know all the difficulties arising in monitoring - we can't give you the information you seek unless we can get together.

Maxwell: Captain Walsh, monitoring is just a rough indication of what we are really after - the alpha emitters - is that right?

Walsh: That's right.

Scott: I don't think I would use the word "rough" - it is a peculiar situation - the relationship of alpha to beta and gamma. It is the final word as far as a ship is concerned. It is almost precise as far as clearance goes. However, I think that we are going to have to go to the Lab. to test these methods of decontamination to know precisely what we are doing. One thing I would like to bring out - Captain Maxwell made the statement that hydrochloric acid works better than possibly citrate. That may be true, but I can't say it is true unless I have done it twenty times. The alpha problem if riddance isn't made now will remain a long time, and it is quite poisonous. Some Laboratory such as we have must check these things as true before a decision can be made.

Maxwell: You are now checking muriatic acid to see if it removes the alpha as well as the other?

Scott: Yes, we are running as assay now on acid samples taken from one of the yard's decontamination process. We can get an alpha count to see how effective the acid is. We have checked this particular point with the citrate, and we are sure that it takes out the alpha as well as the other emissions which show on the monitor's instrument. Before any decisions or statements are made, there should be facts. We should be sure that everybody in this group agrees that they are facts. Everyone can scrutinize the statements in this case. The acid story is not complete until we have done all the laboratory work on it, although the monitor may say that the acid treatment has reduced his readings to zero.

Turnbaugh: This matter of setting up an organization, and of conducting large scale experiments, also of calculating total radioactivity on ship is going to take considerable time to organize, time to run experiments, and considerable time for making conclusions from it. The immediate problem is to pin down a low radioactive limit to strive for. Can we for the present go ahead on the decontamination of the ships based upon some definite outside (gamma) value which you are sure is safe?

Scott: If 25% of the ship's salt water lines read more than 1/100 R per day, this ship should be decontaminated.

Turnbaugh: We can use that basis now and clear what ships are in here.

Scott: If we can get the answers which we are asking we can sit down and figure out what sort of hazards we might have. Then we can set a low limit.

Rodenbaugh: We are in a different position than we were while in Bikini.

Scott: I would say we are about 60% along the road of completion.

Tombaugh: How soon do you think you will have the assay complete on the acid solution you have? We have to make our decision between the muriatic acid and the citrate.

Scott: I think this afternoon, we were fortunate in getting Mr. Morrison from Washington who is now doing the assay. The reason I come to this group is to present the attitude of "what do you want to know" so that I can find out what you need and try to deliver it to you. How far do you want the Lab. to go in research, etc.? I want to find those things out so that we can find out how it can be done.

Walsh: I was talking to Dr. Lyon yesterday and asked him to pass the information to a certain party - that long range policy is a little out of my field. The decision has to be made for benefit of BuShips and BuMed.

[redacted]

Maxwell: I would like to hear from Dr. Rodenbaugh.

Rodenbaugh: I have the impression that the great interest that we have in going over these ships is to find the amount of activity we are dealing with before we can fix the hazard. The activity is not smoothly distributed in the salt water lines - you would have a difficult time estimating how much radiation you have. I sat with a medical board to get some sort of an over-all view. Each ship was different and had to be discussed individually. The decision wasn't easy to make - you could not measure the substance and so the operation was stopped at Bikini. The health hazards of radiation - I have seen a lot of late reactions. I would be very loath indeed to feel that we should take any chance on these hazards until we know more about it. The only protection you have against these things is to stay away from it. As long as it is in the pipe it is all right, but when you take it out that is when you get into trouble. There is a tremendous amount of radiation material on these ships. We still don't know just how much these ships have on them. The pipe lines and the outside hull are two different things.

Scott: The hull - we are safe and my recommendation was, that we could clean ships one hundred times as active as the one we had (LAFFEY). My suggestion was that the sand be dumped at sea. The activity is mixed up in many tons of sand. What we have to avoid is getting this activity in a very small concentrated area. It would seem to me that that operation could be perfectly safe, but on pipe lines we want to be sure that we are doing it in the right manner.

Maxwell: To get back to the question of piping, would it be possible that we take a representative of the pipes aboard ship that's well known to be most contaminated. For example, I would say the auxiliary injection is one of the most contaminated - we take that as a representative section. Then, take one from the evapo rator brine and maybe one from the flushing system. Open those pipes and remove the representative section of debris fro analysis. Couldn't you work up some kind of a survey so that we can use that as a guide on whether to decontaminate other ships?

Scott: Yes. I suppose BuShips knows where scale and rust tends to collect - Where the scale and rust collects is where the activity will collect.

Howell: The bad part of that was illustrated on the BENEVOLENCE. Two feet away from a hot spot rading of 0.9 gamma there is a negligible reading. There seems to be an accumulation around flanges, joints, valves, etc.

Scott: We have to find these places, and I would suggest that these places be minutely gone over.

?: On these ships here, where they had these different heavy marine growth, would that show up on the instruments?

Turnbaugh: Yes - it definitely showed hotter reading than other places.

Morton: I would like to interject what has been brought up - samples in the lab. are of no value unless this information is coordinated. It so happens that we do not get a homogeneous example. We must know if we are to give you the information on whether or not to decontaminate.

Turnbaugh: As long as these active spots are scattered around, it seems that the job of calculating total activity in a ship to determine whether or not to decontaminate is going to be a big job. It seems simpler to decontaminate the whole ship.

Scott: You will have a high manpower cost one way or the other.

Turnbaugh: After we decontaminate you can easily get total activity from our used solution.

Lemler: There are three types of ships involved: Active Ships, all of which have operating schedules. This is of most importance and at the same time safety cannot be disregarded. I would suggest that we decontaminate those ships down low until you get to a low figure that's safe beyond a shadow of a doubt. Any information collected during the process will be of value for future ships.

The second group: Deactivated ships. Time isn't so important so you can do some experimentation; because time is not so important, a planned, controlled experimentation.

Third group: I think your big experimentation can go forward on the target ships that are coming in here. The sole purpose of bringing them here is to see what happens and how you can cure these things. The information you have gathered on the first and second groups you can apply to this third group, taking as much time as you need.

We have our instructions from BuShips as to what to do. It seems to be working so, if we are reasonably sure of being right in the procedure for cleaning the ship up, let's continue on these active ships. We will take out readings as before, and let Dr. Walsh clear the ship using the standards he has; but we will forget the experimentation work on those ships except for collecting data as to what was done. We will on a productive basis comply with BuShips directives in decontaminating.

Scott: I don't really think there is any difference in an experiment and really cleaning up a ship. As far as your difficulty in cleaning up pipe lines, I would have suggested a little different procedure which might have saved you time.

In that manner we could not act as consultants. Every time we do a job it is an experiment. I think the entire group is aware of such work. Really, these things are all experiments in a sense. By experimentation I don't think it was meant that we would set this ship aside and keep it as a place where we could work out ideas as they occur to us. Since we have had long experience with the field we are well aware of what is actually happening in those pipes than is someone who is now in this sort of thing.

Maxwell: Commander Hoffman is here from Washington. He has had some experience in this decontamination, at Bikini.

Hoffman: About all we came out for is to see what you are doing. At the present time, what Admiral Solberg particularly wants is to develop a procedure that we can issue as a

[redacted]

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step by step method to any Yard or a ship, and that we are sure will be clear and concise enough to do the results beyond the question of being safe. He wants to take the ROCKBRIDGE particularly to work out such a thing as Dr. Scott suggested - to clean her up so that we can forget that she was ever active.

Maxwell: Let us appoint Commander Hoffman and Dr. Morton to work with the Yard and Berkeley to get this thing rolling. In conclusion, we will recommend to the Bureau these two solutions - the ammonium citrate and the acid if it is favorable (when we hear from Dr. Scott). The yard is to continue with experiments to develop a better method if it is possible. I think with Dr. Morton being in the picture we will get some data which will be of use in preparing definite instructions for decontamination work.

Walsh: I think the next point is to decide about the ROCKBRIDGE.

Maxwell: Go ahead with the decontamination work on ROCKBRIDGE.

Walsh: You propose to use acid on salt water systems?

Maxwell: We must get the answer from Dr. Scott as to whether or not the acid is as effective in removing the alpha particles as the gamma and beta. We know that ammonium citrate does remove the alpha particles, although it doesn't remove sea growth as well as the acid.

Wynn: Do you propose to work the whole system over?

Maxwell: Yes. Is that agreeable? The experimental work will be done at Hunter's Point.

Scott: I don't see why we can't get a lot of valuable information out of work that's being done elsewhere. You are setting up a laboratory at these other yards, are you?

Maxwell: No - just this one. Of course, there will be monitors at the other yards. The other yards are exclusively on the west coast - Puget Sound, Terminal Island, Mare Island.

Lemler: What do we do with the hydrochloric acid - can we pump it at sea 10 miles out?

Scott: It gets diluted there so you don't care if it is active.

Turnbaugh: We have been considering trying to filter that.

Scott: I rather feel the major part of the activity is dissolved in the acid.

Lemler: A question: we take a section of pipe out and with the idea of replacing it. Our present plans are to take the old pipe to sea and dump it even though the readings say it is not particularly dangerous. Is this for security reasons?

Scott: It may not be dangerous, but if all the rust and scale inside that pipe gets into one lump you could conceiveably have a lot of radiation.

Rodenbaugh: It is difficult to get rid of radioactive matter. It may be a lot cheaper to dispose of a valve than to try to get rid of the radiation hazard on the valve.

Maxwell: Dr. Scott, one more point to be clarified - before we start decontaminating these salt water systems we should have a standard, and that standard was not determined - just a figure that was pulled out of the air. I understand that there is a possibility that the scale and debris may get into one lump and that will cause trouble. Couldn't we find out the amount of activity in the ship - some method we could find out such as the total area of the pipe system, and also the amount of debris in these pipes?

Scott: It seems to me that we could work up some sort of a usable method. We could sample a solution from one of the decontamination jobs. If we know we have removed 90 to 98% of radioactivity in this process then we know how much radioactivity there was in the lines treated. I think you could then assume on a similar ship if you have a similar monitor's report you know how much activity there is. The other way would be to sample the pipe at enough points and get at it that way. A calculated result. That was the type of thing I was going to try to get for you if you could get in these areas. For example, we take the HENRICO - we know by a sample that the rust on the pipe that leads to the crew's head has so much activity per cubic centimeter. I also know the rust is 20 mm deep. Similar observations could be made throughout the ship. Then I think we could calculate how much activity we would have in that ship. Then I think we could consult with someone like Dr. Rodenbaugh and see if he thinks that amount is dangerous. Also get together to see if that amount would come together and actually be a hazard. Give me the information as to areas and mass of material in the pipes along with representative samples.

Howell: We have some information for you now.

Scott: We can give you some answers. That's the only way to do this - unless you do it like you did on the destroyer (measuring after the job is done). What I would like to do is break these ships down into units and consider each type of contamination as a different problem. Take evaporators and their lower limit. People obviously aren't going to collect scale or carry it around and I, personally, from what I have seen of evaporators would be willing to clear the things if they read less than 1/10 R a day.

Turnbaugh: It is not merely a question of safety on a ship in the personnel being near an active unit for a twenty-four hour period. The yard has the problem of working on the inside of evaporators and of working valves in the shop. The low limit must consider this.

Scott: There is a point that I am not aware of. My only suggestion there is that any of those operations have to be monitored. I would have to know the actual mechanics of the repair work.

Rodenbaugh: You still would have to know what substances cause emission.

Scott: Our whole premise has been based on knowing the ratio of beta to alpha activity before we would have something to work on. Last month that was worked out in the Lab. to semi completion. If we find that always to be true, I think you can have the control measure.

Lemler: Summarizing this meeting: First, a suggestion was made that we organize a steering committee for the work here. That wouldbe representatives from BuShips, BuMed and U. of C. The purpose of it would be to develop procedures and to disseminate information. Second, we will continue along on our present procedures and try to deactivate the active ships to the satisfaction of Dr. Walsh. He provides the monitor. Third, the long range experimentation - my guess is that it will be done on the target ships primarily and on the active ships secondarily.

Scott: I wonder if there is some way we can get this in writing?

Rodenbaugh: I would like to get some samples of this marine growth in pipes.

Scott: I would like to have a list of the selected personnel for this secret and confidentail matter to use so I will know who to give this information to.

C O P Y

[redacted]

FROM: BUSHIPS/CODE 180 FEE/b 102030Z

TO: COM TWELVE DIST MED OFF

INFO: BUMED
CJTF ONE

PASS TO CAPTAIN WALSH FOR ACTION X BUSHIPS AND BUMED PROPOSING ESTABLISH LIMITS FOR FINAL RADIOLOGICAL CLEARANCE AND DECONTAMINATION FOR ALL NON TARGET INCLUDING INACTIVE AND DISPOSAL SHIPS AS FOLLOWS X ALL READINGS IN ROETGENS PER DAY COMBINED BETA AND GAMMA CORRECTED TO ONE OCTOBER AND TAKEN AS CLOSE AS PRACTICABLE TO RADIOACTIVE MATERIAL X GRANT FINAL CLEARANCE WHERE ABLE RADIOACTIVE MATERIAL ENCLOSED IN METAL OR OTHER SHIELDING MEDIUM AS IN SALT WATER SYSTEMS IF ALL READINGS ARE POINT ZERO ONE OR LESS SEMICOLON BAKER WHERE NO SHIELDING MEDIA INTERPOSED AS ON HULL OF SHIP IF ALL READINGS POINT ZERO TWO OR LESS X WHEN NOT WITHIN ABOVE LIMIT ABLE AND TWENTY FIVE PERCENT OR LESS READINGS OF THE FOULED SYSTEM ARE BETWEEN POINT ZERO ONE AND POINT ONE DECONTAMINATE SYSTEM OR EQUIPMENT SOON AS PRACTICABLE BUT IF MORE THAN TWENTY FIVE PERCENT ARE ABOVE POINT ZERO ONE OR ANY LOCALIZED AREA EXCEEDS POINT ONE DECONTAMINATE IMMEDIATELY SEMICOLON WHEN NOT WITHIN ABOVE LIMIT BAKER AND READINGS ARE BETWEEN POINT ZERO TWO AND POINT ONE DECONTAMINATE SOON AS PRACTICABLE BUT DECONTAMINATE IMMEDIATELY ANY AREAS READING OVER POINT ONE EXCEPT THAT UNDERWATER HULL NEED NOT BE DECONTAMINATED UNTIL FIRST SCHEDULED DOCKING IF CLEARANCE LIMITS EXCEEDED X WILL OMIT SPECIAL SAND BLASTING OF BOTTOM AT FIRST SCHEDULED DOCKING IF ALL UNDERWATER BODY READINGS ARE POINT ZERO TWO OR LESS X

[redacted]

ACID CLEAN ALL EVAPORATORS AS PRECAUTION REGARDLESS OF READINGS X PARA X REQUEST YOU DISCUSS THESE STANDARDS WITH HAMILTON AND SCOTT AND SEND COMMENTS AND RECOMMENDATIONS BY DISPATCH X REQUEST SPECIFIC RECOMMENDATION AS TO LIMITS ABOVE WHICH IMMEDIATE CLEANING CONSIDERED NECESSARY FOR SAFETY REASONS AND ANY TIME LIMITATION NECESSARY TO IMPOSE ON CLEANING WHEN CONTAMINATION BELOW THAT REQUIRED IMMEDIATE WORK BUT EXCEEDING LIMITS FOR FINAL CLEARANCE

2153/10 OCT AC

102030Z

[redacted]

FROM: COMWESTSEAFRON OCTOBER 112327Z

TO: BUSHIPS

INFO: BUMED
COM JTF ONE

RESTRICTED X YOUR ONE ZERO TWO ZERO THREE ZERO X CONFERRED WITH HAMILTON FOLLOWING COMMENTS SUBMITTED X ABLE SALT WATER SYSTEMS EVAPORATORS HEAT EXCHANGERS ECT GAMMA OUTSIDE READINGS POINT ZERO ONE FOR ACTIVE SHIPS BUT POINT ZERO ZERO ONE FOR INACTIVE AND DISPOSAL X TWENTY FIVE PERCENT FIGURE OF POINT ZERO ONE AND POINT ONE ARE CONCURRED IN X BAKER WHERE NO SHIELDING AS ON HULLS BETA AND GAMMA READINGS POINT ZERO FIVE FOR ACTIVE VESSELS BUT POINT ZERO ZERO FIVE FOR INACTIVE AND DISPOSAL X WHEN NOT WITHIN LIMIT BAKER AND READINGS ARE BETWEEN POINT ZERO FIVE AND POINT FIVE BETA AND GAMMA DECONTAMINATE AS SOON AS PRACTICABLE DECONTAMINATE IMMEDIATELY ANY AREA READING OVER ZERO POINT ONE GAMMA EXCEPT UNDERWATER HULL NEED NOT BE DECONTAMINATED UNTIL FIRST SCHEDULED DOCKING IF CLEARANCE LIMITS EXCEEDED PROVIDED HULL READINGS INSIDE VESSEL DO NOT EXCEED ZERO POINT ONE GAMMA X SANDBLASTING NOT NECESSARY IF ALL UNDERWATER BODY READINGS ARE POINT ZERO FIVE COMBINED BETA AND GAMMA OR LESS BUT FOULING SHOULD BE REMOVED USING WET TECHNIQUE X CONCUR IN ACID CLEANING EVAPS X SPECIFIC RECOMMENDATION X IMMEDIATE CLEANING REQUIRED OF ANY EXPOSED AREA WHERE RADIATION EXCEEDS POINT ONE ROENTGEN BETA AND GAMMA PER DAY X TIME LIMITATION OF NINE MONTHS FROM ONE OCTOBER X STANDARDS RECOMMENDED FOR DISPOSAL AND INACTIVE VESSELS BASED PRIMARILY ON MEDICAL LEGAL AND SECURITY ASPECTS X

(CORRECTED COPY: CORRECTIONS UNDERLINED)

[redacted]

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1. October 1946

MEMORANDUM FOR FILE

Subj: Radiological Decontamination; Conference Concerning.

1. A conference was held on the subject of Radiological Decontamination in Room 4103, New War Department Bldg. at 0545, 4 October 1946. Those present were:

Vice Admiral Blandy
Rear Admiral Solberg
Captain Lyon
Captain Rivero
Col. Nichols
Commander Langer
Commander Fee
Doctor Hamilton
Col. Roper

2. Admiral Solberg opened the conference with the remarks that the Navy's radiological decontamination problems are roughly divided into two broad categories: (a) the decontamination of radioactive ships now on hand, and (b) a long range program of radiological decontamination research, development and education. Admiral Blandy stated that the divisions of naval radiological decontamination activity are specifically divided into the following categories:

(a) Decontamination of active ships for overhaul and operation.
(b) Decontamination of ships destined for inactivation or disposal (of less immediate importance).
(c) A long range program of preparation for wartime decontamination measures.
(d) Sending to navy yards for decontamination the target ships after ammunition has been removed.

3. Admiral Solberg advised that BuShips and BuMed had jointly issued a speedletter prescribing necessary measures to permit active ships to operate without hampering of operation or repair. Final instructions on decontamination measures must be promulgated for active ships for protection of personnel, and for inactive and disposal ships having in mind both medical and legal protection.

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Experimental work is being prosecuted actively at University of California on steel and copper-nickel salt water piping decontamination using hydrochloric acid and ammonium citrate. The Achomawi (ATF-148) is being sent to Hunters Point for development of decontamination measures on this type vessel. This ship's employment produced considerable radioactivity. The Rockbridge (AFA-228) is also undergoing decontamination with complete data being obtained on conditions before and after applying procedures. These experiments will provide information as to decontamination cost which is of vital importance in view of scarcity of funds. It was originally intended to do no work on salt water lines of active ships, but it is now proposed to conduct an acid cleaning at the first overhaul in order that all restrictions can be removed regardless of future disposition. Admiral Solberg outlined the procedures being followed on cleaning of evaporators and underwater bodies. Target vessels are not considered in the same class with non-targets and require special studies for topside decontamination. Salt water lines and evaporators will not be a problem, because these systems were not in use on target ships during the danger period.

4. Admiral Solberg explained that BuShips is now engaged in preparing final instructions for decontamination of all non-target ships. These instructions will supersede all previous directives and will contain an introduction outlining general considerations followed by specific instructions for the three classes of non-target vessels. A draft of the introduction was circulated among the conferees. Admiral Solberg stated that he hopes to get drafts of the instructions to the West Coast personnel for their comment prior to promulgation.

5. Admiral Blandy raised the question of classification of matter regarding decontamination. All agreed that the information should be reduced to a restricted classification and that the public relations angle should be considered carefully to remove confusion and the impression that the Navy is "covering up." This matter is now under study, but must be cleared with Manhattan District.

6. Dr. Hamilton reported that his work on the West Coast is proceeding very satisfactorily and that liaison with the naval activities there is excellent. Dr. Hamilton stressed the need for cleaning salt water lines on ships scheduled for inactivation because of breathing

hazard due to the practice of blowing air through salt water systems. In the case of active ships, Dr. Hamilton agreed to deferring cleaning up pipe lines on active ships until regular overhaul, but stressed the need for reducing the time elapsed to nine months if possible because of the decay rate of beta material and the difficulty of detecting alpha emitters after decay has progressed beyond that time. Cleaning of bottoms is of least concern and can be deferred until docking is required for other purposes regardless of time involved. The leaching out process of the bottom paint will in most cases cause marine growth to fall off to some degree carrying alpha emitters with it. In this connection Dr. Hamilton suggested experiments with plates prepared with plastic paint and contaminated with radioactive material to determine what can be expected on underwater bodies of ships. He suggested contamination by a mixture of plutonium and fission products. Admiral Solberg raised the question of provision of the material, to which Col. Nichols replied that he felt the arrangements could be made.

7. Dr. Hamilton raised the question of the fundamental relation and function of the University of California in connection with the Army and Navy in their decontamination work. He went on to state that the job should be attacked quickly and thoroughly because of the rapid decay rate of beta material. He also stated that he felt that individuals should be trained both in the technical and overall aspects of decontamination. He recommended that Hunters Point undertake practical naval experimental work with assistance as necessary on technical matters from the University of California. He said that naval personnel or civil service personnel should be trained in this line as civilian personnel are most difficult to obtain for the work. Captain Rivero brought out the fact that recent Naval Academy graduates will in the very near future be recalled from monitor work for sea duty.

8. Admiral Solberg stated that the plan is to train for long term decontamination work. However, the immediate press of work in hand requires personnel on a short term basis to clean up ships already back and those to be sent back in the near future. This will be followed with a long term monitor program for target vessel cleanup. At the present time, the decision must be made as to which group of personnel should be trained in this type of work. At first glance, it would appear that electronics personnel would be the logical choice.

Dr. Hamilton stated that he considered essential a knowledge of radiochemistry as well as knowledge of repair and operation of instruments. Admiral Solberg indicated that the chemistry background would not be necessary for immediate work now in hand or for wartime decontamination procedures to which present investigations will lead. Chemists will be required for research work only. Other groups will be trained in sonitoring. These may include all naval officer postgraduate students regardless of what types of courses they are pursuing, damage control officers and other selected groups. The course will be one of probably four weeks duration on decontamination procedures, and will be designed to disseminate knowledge of the problems to be expected and methods of coping with them. Captain Lyon stated that medical personnel will also have a definite training program in radiological decontamination. Admiral Solberg stressed the need for all medical officers to take the course. Dr. Lyon replied that negotiations with BuPers are underway but no definite policy has yet been derived. A five day course to give a general picture to senior medical officers is being developed. The senior officers of BuMed are now observing at the Radiological Safety School, and weekly conferences are held with these officers on determination of school policy.

9. Admiral Solberg explained that there are several major problems facing the Navy, but there are not sufficient personnel available at present to handle them competently. Dr. Hamilton complimented the Navy on the excellent approach already made to the problem and the splendid long range program under consideration.

10. Admiral Solberg advised Dr. Hamilton that samples of radioactive material must be taken from ships as frequently as possible to be analysed for background of experience and to aid in assessment of activity on future ships. According to Dr. Hamilton this procedure is being followed within the limits of present facilities, and although good samples are being obtained, ex-target ships will offer a more fruitful field. Admiral Solberg pointed out that some targets are coming to the West Coast in the immediate future and analysis on these should commence as soon as possible. Dr. Hamilton again stressed the point that in order to handle this work properly, the Army and Navy must make attractive offers to personnel to engage in radiological safety and decontamination. The principal problem in this case is not, as Dr. Lyon thought, a financial one, but rather a case of encouraging

competent men to enter the field by assuring them that they will be kept on that particular type of work throughout their employment and will be guaranteed a long term period of service. In this respect Admiral Solberg believed that the Army and Navy must present a united front on the problem in order to gain support of the program and should develop a combined school for education in radiological work. The closest liaison must also be maintained in the development of all phases.

11. Captain Lyon discussed the work of the Navy Radiological Safety School briefly and commented on the instructors and type of lectures being given. He promised to disseminate copies of the material of the course as soon as available in printed form.

12. Dr. Hamilton raised the question of the permanency of the laboratory at Hunters Point. Admiral Solberg indicated that no commitments had been made along this line as yet. He also said that a basic directive for the proper establishment of the laboratory must be developed. No one knows as yet all the phases requiring attention and the development will perforce be a gradual process as more information becomes available. Captain Rivero advised that in the Navy Department Admiral Wright will assume control of new developments in CNO, with Admiral Parsons remaining in charge of Atomic Energy and guided missiles, and in this capacity handling problems resulting from CROSSROADS. Dr. Hamilton believes that his facilities can be of most value in training personnel and assisting in the setting up of the laboratory at Hunters Point. He considered that three or four officers and six pharmacist's mates would suffice for a start. Admiral Solberg advised Col. Nichols that present arrangements between the Navy and University of California are quite satisfactory.

13. Col. Nichols stated that Army problems in radioactivity are very broad and that the question of atomic warfare again requires review. Dr. Hamilton believes round table discussions between the Army, Navy and civilian scientists are in order in developing the subject. Col. Nichols advised Dr. Hamilton that he would like to have from him, when convenient, a suggested long range decontamination program including both Army and Navy and also his thoughts on atomic warfare.

14. Admiral Solberg stated that the Navy's problems are two:

(a) What type covering can we use to avoid taking up radioactive material?

(b) What are the best decontamination methods for present and prospective materials?

Col. Nichols suggested that the Army and Navy should devote their studies to specific applications of decontamination leaving to civilian scientists the development of the field of general knowledge of radioactivity. Admiral Solberg made the point that all research work in the field must be coordinated, and laboratories and agencies must maintain the closest liaison to avoid duplications and to give all investigators the benefit of new discoveries or developments by individual activities. Dr. Hamilton suggested from this standpoint that it might be advisable to shift the laboratory from Hunters Point to Washington in view of the superior scientific facilities available here. Admiral Solberg said that radiological research and development must be conducted individually and separately from other fields. Dr. Hamilton questioned the possibility of Army-Navy nuclear energy studies. Col. Nichols considered that Manhattan Project is just that. Captain Lyon said that Dr. Hamilton could be of most value in detection and analysis procedures. Dr. Hamilton said that at present the establishment of standards is mainly guess work and calculated risk. The practical side of the work must be considered throughout by persons familiar with ship operating and repair procedures. Further, the more advisers the more ridiculous the standards because of the personal variation in opinions of safe limits. Bi-weekly discussions of new developments and problems and crystallization of ideas would be of great help to all concerned.

15. Col. Nichols questioned Dr. Hamilton as to his additional requirements to accomplish the job before him. Dr. Hamilton advised that he is making satisfactory progress with present facilities by robbing long range research problem studies which he is loath to do. However, he believes the best procedure at present would be to train Navy people to meet immediate problems. Civilian experience will develop naturally in connection with the work as time goes on. Dr. Hamilton suggests that some Army and Navy personnel sit in on the course at Berkeley next spring, without enrolling, merely to obtain a background as to general considerations and problems to be expected. Dr. Hamilton promised to determine

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from the authorities at University of California whether arrangements can be made to have some of Captain Walsh's and Captain Maxwell's personnel sit in on the course on this basis. Admiral Solberg suggested also that Mr. Gordon, Hunters Point Chemist, be permitted to take the course for information and experience.

16. On being questioned as to standards which could now be adopted for decontamination, Dr. Hamilton stated that the problem is one of determining the total quantity on plutonium in a ship and then determining whether that is a dangerous quantity if accumulated at one spot. Other than this standard, clearance is mainly a case of calculated risk and good judgment. For practical purposes, he indicated that for an active ship, if less than 25% of readings showed as high as .01 to 0.1, decontamination could be omitted, but if 25% of readings were 0.1 or above the ship should be decontaminated immediately.

17. The conference adjourned at 1035.

J. J. FEE,
Commander, U. S. Navy

cc: All present.

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C O P Y

16 October 1946

MEMORANDUM FOR CAPTAIN WALSH

Subject: Tolerance Figures.

1. For present final radiological clearance can only be on basis of 0.001 for shielded beta and gamma conbined and .005 for unshielded beta and gamma combined.

2. It is most desirable that an Advisory Board to BuMed be formally created to act formally on this matter and return report to Chief, BuMed.

3. I will prepare letters of requests to serve on this board for signature of the Surgeon General.

(a) Dr. Newell
(b) Dr. Rodenbaugh
(c) Dr. Scott
(d) Dr. Hamilton
(e) Dr. Langham
(f) Lt. Morton to serve as Secretary
(g) Captain Walsh to serve as Chairman
(h) Colonel Warren may be invited when he is available.

4. The letter will set forth the mission of the Board.

5. BuShips representative may be present for deliberations if you desire.

6. Essentially this is strictly a BuMed responsibility - i.e. the placing of (a) levels of tolerance and (b) assessment of hazard not indicated by simple readings (quantity relationships).

G. M. Lyon
Capt., (MC), USNR

[redacted]

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C O P Y

DRAFTED BY: FEE/kulick

25 OCTOBER 1946

FROM: BUSHIPS

TO: COMWESSEAFRON 252132Z

INFO: BUMED
CJTF-1

ADVISE WHETHER INTERPRETATION UR 112327Z AND 121747Z IS THAT UNDERWATER BODY MEETS REQUIREMENTS FOR FINAL CLEARANCE ALL VESSELS IF ALL READINGS ARE POINT ZERO FIVE COMBINED BETA AND GAMMA OR LESS X ALSO ADVISE WHETHER READINGS SPECIFIED ARE TAKEN WITH HULL WET OR DRY X

R E S T R I C T E D

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C O P Y

WN134

NS163
T3-3-3
P P P
WNDE WNNA SNC V SNFH NR 25 P

FM NAVSHIPYD SANFRAN 301946Z
TO BUSHIPS CODE 180/WNDE

INFO BUMED/WNNA CWSF/SNC

REFURDIS 252132 X INTERPRETATION CORRECT X DRY READINGS
X CAPTAIN WALSH SENDS

1945Z/30 OCT DK 301946Z 252132

C O P Y

[redacted]

FROM: BUMED

TO: COMWESSEAFRON

DRAFTED BY: G. M. LYON

INFO: BUSHIPS

8 NOV. 1946

082128Z

NCR 588

REUR 071837Z. BOARDS FINDINGS YOUR 060145Z INTERPRETED AS RECOMMENDING AVERAGE WET READING .02 COMBINED BETA AND GAMMA FOR CLEARANCE UNDERWATER BODY. HAD TENTATIVELY ESTABLISHED .1 BETA AND GAMMA AS MAXIMUM ALLOWABLE FOR ANY ONE ISOLATED AREA. BUSH: 071415Z BASED ON THIS LIMIT WITH WHICH SYLVANIA AND WHARTON COMPLY ACCORDANCE DETAILED REPORT NAVSHIPYD PUGET SOUND CONF SPDLTR SER 0770 OF 29 OCT USING HULL READINGS VICINITY WATERLINE AS INDEX C ADVISE PRIORITY IN WHAT RESPECT THIS CONFLICTS WITH BOARDSRECOMMENDATIONS. IN LIGHT OF BOARDS STAND WHAT IS YOUR OPINION IN REGARD TO RECLAIMER BAY FIELD AND POLLUX AS REPORTED IN NAVSHIPYD PUGET SOUND SPDLTR SER 0775 OF 4 NOVEMBER

BUMED.....ORIG

BUSHIPS.....

[redacted]

082128Z

[redacted]

FROM: CWSF
TO: BUMED 151807Z

REFURDIS 062130 X BOARD RECOGNIZES DESIRABILITY OF ONE SET OF STANDARDS FOR ALL SHIPS X CATEGORIES SET UP IN ATTEMPT EARLY RELEASE ACTIVE SHIPS FOR OPERATIONAL PURPOSES WITH PROVISO THAT DISPOSAL STANDARDS WOULD BE MET AT LATER DATE IF REQUIRED X AMOUNT OF ACTIVITY ALLOWABLE FOR OPERATIONAL PURPOSES MUCH GREATER THAN SHIPS FOR SCRAP X ADEQUATE METHODS AVAILABLE TO REACH READINGS OF POINT ZERO ZERO ONE SHIELDED AND POINT ZERO ZERO FIVE UNSHIELDED X POINT ZERO TWO AVERAGE HULL READINGS DRY WITH SELF ABSORPTION DIFFERENTIAL THIRTY PERCENT X THIS MEANS HULL WITHOUT HAZARD AND SATISFYING FINAL CLEARANCE REQUIREMENTS X QUESTION E MEASUREMENTS TAKEN INSIDE SHIELDED X DOCKING DEPENDENT ON STATISTICAL AVERAGE WHEN SYSTEMATICALLY MONITORED READINGS COMPLY WITH ABOVE STANDARDS ON PORTIONS OF UNDERWATER BODY EXPOSED BY LISTING AND TRIMMING TO MAXIMUM PRACTICABLE EXTENT X

151807Z Nov.

[redacted]

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COPY

FROM: BUSHIPS-BUMED

TO: RADSAFE HDQ NAVSHIPYD SAN FRAN

INFO: COMWESSEAFRON

111605Z

PLEASE PASS TO CAPT WALSH X REQUEST CONFIRMATION OF ADVISORY BOARDDECISION THAT ANCHORCHAINS ANCHORS AND CHAIN LOCKERS HAVE SAME LIMITS FOR FINAL CLEARANCE AS UNDERWATER BODY OF SHIPS HULL X

COPY

WN9

SN C133

2-2-2
D D D
WNNA WNDE √ SNC NR B50/ 9 D

FM COMWESTSEAFRON 091907Z
TO BUMED/WNNA

INFO BUSHIPS/WNDE

YOUR 051942Z OPINION OF BOARD LESS NEWELL X SMALL BOAT HULLS SAME FIGURES AS SHIPS HULL X ENGINES SAME FIGURES AS SALT WATER SYSTEMS X HULL AREAS MAY BE COVERED WITH MULTIPLE COATS OF ENAMEL OR SIMILAR RESINOUS PAINT

2140/9 DEC UG 091907Z 051942Z

[redacted]

C O P Y

FROM: COMWESSEAFRON

TO: BUMED

12 NOV 1946

INFO: BUSHIPS

111917Z

NCR 4830

BOARD RECOMMENDATION MAXIMUM DRY READING .02 COMBINED BETA AND GAMMA ON HULL FOR DISPOSAL VESSELS. YOUR 082128. STATISTICAL AVERAGE READINGS WERE NOT CONSIDERED ACCEPTABLE ALTHOUGH BOARD AGREED TO ACCEPT 1 LOCALIZED AREA IN EXCESS OF ABOVE LIMIT BUT EACH CASE SHOULD BE SETTLED ON ITS OWN MERITS BY BUMED. PUGET SOUND SPDLTRS 0770 AND 0775 NOT HELD. YOUR 082130. QUESTION B. DRY READINGS. HULL WITHOUT HAZARD AND SATISFIES FINAL CLEARANCE REQUIREMENTS. QUESTION E. MEASUREMENTS INSIDE SHIP SHIELDED. AMPLIFYING DESPATCH FOLLOWS TOMORROW.

[redacted]

111917Z

[redacted]

COPY

Un165

SN165 DEC. 12

2-2-2

R R R
WNDE R
SNFH D V SNC NR 143/12 R

FM COMWESTSEAFRON 121907Z
TO BUSHIPS CODE 180-A R/WNDE

INFO RADSAFE HDQTRS NAVAL SHIPYARD SANFRAN D/SNFH

RESTRICTED X THIS CONFIRMS ADVISORY BOARD DECISION THAT ANCHOR CHAINS ANCHORS AND CHAIN LOCKERS HAVE SAME LIMITS FOR FINAL CLEARANCE AS UNDERWATER BODY OF SHIPS HULL X THIS INFORMATION INADVERTENTLY OMITTED FROM PREVIOUS DESPATCHES AND WRITTEN RECOMMENDATIONS

1907/12 DEC FV 121907Z

[redacted]

COPY

P P P

SNC V WNNA NR 16 P

FM BUMED 252116Z

TO COM 12

ATTN CAPT W E WALSH MC USN X SPECIAL MEDICAL ADVISORY BOARD TO BE FORMALLY ORGANIZED IN ACCORDANCE WITH MEMORANDUM OF CAPT LYON TO CAPT WALSH RELATIVE THERETO X PRESENT REQUESTS TO BOARD IN WRITING FOR THEIR CONSIDERATION AND RECOMMENDATION TO CHBUMED VIA CAPT WALSH X PRESENT TO BOARD FOR FORMAL CONSIDERATION AND RECOMMENDATION SPECIFIC PROBLEMS SUCH AS X ABLE X RAISING FINAL CLEARANCE SHIELDED READINGS TO POINT ZERO ONE AND UNSHIELDED POINT ZERO FIVE MAXIMUM ANY PLACE X BAKER X VARIABILITY AND PROBABLE UNRELIABILITY XRAY TWO SIX THREE BELOW POINT ZERO ONE WITH SUBSTITUTION LOWER READINGS EARPHONE COUNT AS TO BACKGROUND OR NUMBER OF TIMES BACKGROUND FOUND X CHARLIE X PROBLEM ALL SHIP BELOW ACCEPTED TOLERANCE FINAL CLEARANCE EXCEPT ONE LOCALIZED FLAT SURFACE ON HULL ABOVE POINT ONE X DOG X SAME EXCEPT IT BE ONLY ONE SECTION PIPE OR ONE EVAPORATOR ABOVE FINAL CLEARANCE TOLERANCE X THESE AND MANY OTHER BOTTLE NECK PROBLEMS TO BE PRESENTED FOR THEIR CONSIDERATION AND RECOMMENDATION X MUST BE A COLLECTIVE OPINION NOT INDIVIDUAL X INCLUDE ON BOARD WALSH MORTON SCOTT HAMILTON RODENBAUGH NEWELL AND WHEN AVAILABLE LANGHAM AND WARREN X LANGHAM AVAILABLE FOR MEETINGS ON REQUEST X COLONEL WARREN CONCURS IN PLAN X SIMILARLY PRESENT TO BOARD PROBLEMS AND VIEWPOINTS SO WELL SET FORTH IN BARNES TWENTY THREE OCT TO CAPT LYON X SCHNEIDER TO UNDERSTUDY WALSH IN PREPARATION HIS PROBLEMS ON TARVES AND RELIEVE WALSH EVENTUALLY X WALSH CONCENTRATE ON PUSHING ACTIONS OF BOARD X THIS OUR MOST CRITICAL PROBLEM X REQUEST WULFMAN BE RETURNED TO BUMED BY FIFTEEN NOV TO ASSIST IN RADIOLOGICAL SAFETY SCHOOL FOR MEDICAL OFFICERS BEGINNING FIFTEEN NOV X THIS DISPATCH YOUR AUTHORITY APPROACH ADVISERS TO BE KNOWN AS SPECIAL MEDICAL ADVISORY BOARD TO CHBUMED X

LTRS TO BE SENT TO EACH INDIVIDUAL AS SOON AS POSSIBLE X MEDICAL MONITORS EXCEPTING HARRIS TO BE RETAINED IN RADIOLOGICAL SAFETY WORK UNTIL ONE JAN AND THEN RELIEVED THIS DUTY X RECOMMEND BARNES RELIEVE WULFMAN IF MEDICAL OFFICER REQUIRED AFTER WULFMAN LEAVES X MEDICAL OFFICERS WITH RADSAFE TRAINING AVAILABLE BY ONE JAN
2116/25 OCT VD 242116Z

FROM: COMWESSEAFRON FOR ACTION: CHBUMED

DATE 6 Nov. 1946

TOR CODE ROOM 1146/06

DECODED BY BUCKLEY

TYPED BY ROBERTS

060145Z NCR 4371

CONFERENCE HELD 4 NOV WITH NEWELL RODENBAUGH, HAMIL-TON, SCOTT, MORTON. QUESTION (A) RAISING OF FINAL CLEAR-ANCE OF SHIELDED READINGS TO .01 ANSWER SHIELDED ACTIVE SHIPS .01 GAMMA. SHIELDED INACTIVE AND DISPOSAL SHIPS .001 GAMMA. B. QUESTION RAISING OF FINAL CLEARANCE OF UN-SHIELDED READINGS TO .05 MAXIMUM ANY PLACE. ANSWER. ACTIVE SHIPS .05 BETA PLUS GAMMA. INACTIVE AND DISPOSAL SHIPS .005 EXCEPT .02 ON HULL. C. VARIABILITY AND UNRE-LIABILITY OF X 263 BELOW .01 WITH SUBSTITUTION LOWER READINGS EARPHONE COUNT AS TO BACKGROUND OR NUMBER OF TIMES BACKGROUND FOUND; DISCUSSED AT LENGTH WITH CONCLUSION THAT 263 IS UNSATISFACTORY BUT BEST AVAILABLE INSTRUMENT AT PRESENT KNOWN RADIUM SOURCES FOR COMPARI-SON SHOULD BE PROVIDED WHICH SHOULD ENABLE MONITOR TO DETECT .001. D. PROCEDURE WHEN READINGS BELOW TOLERANCE FOR FINAL CLEARANCE EXCEPT ONE LOCALIZED FLAT SURFACE ON HULL. ANSWER. EACH CASE MUST BE INDIVIDUALLY SETTLED CONSIDERING SIZE OF AREA INVOLVED AND MAGNITUDE OF DE-CONTAMINATION REQUIRED. E. SAME QUESTION EXCEPT ON SEC-TION OF PIPE OR EVAPORATOR. CLEAN TO BELOW TOLERANCE EXCEPT INTAKE OR OVERBOARD DISCHARGE OUTBOARD OF VALVE TO BE CONSIDERED AS PART OF HULL. F. QUESTION. ASSUMING THAT ROCKBRIDGE UNDERWATER HULL REPRESENTATIVE OF WORST TYPE SHIP ENCOUNTERED WILL DOCKING BE REQUIRED PRIOR TO CLEARANCE. ANSWER. SHIPS PRIOR TO DISPOSAL MUST MEET STANDARDS RECOMMENDED. G. QUESTION. OPINION AS TO RELIABILITY OF WATER LINE READINGS AS INDEX OF UNDERWATER BODY CONTAMINATION. ANSWER. NO VALUE. MAY BE OF VALUE IF SHIPS HEELED OVER FOR READINGS. RECOMMEND ATTEMPT BE MADE TO CORRELATE INTERNAL AND EXTERNAL READINGS AS MORE SHIPS ARE DOCKED. H. OPINION AS TO ESTABLISHING POLICY OF NOT REQUIRING DRYDOCKING FOR ANY SHIP IF HULL READINGS ARE BELOW .05. ANSWER. ACTIVE SHIPS .05 INACTIVE .02. I. OPINION OF BOARD AS TO ACCEPTANCE AVERAGE READINGS OF .005 SHIELDED AS NEARLY

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STATISTICALLY DERIVED AS POSSIBLE WITH NO SINGLE AREA OVER .05 IN ATTEMPT TO GET AT QUANTITATIVE ASPECT OF CONTAMINATED MATERIAL PRESENT. ANSWER. MORE EXPERIENCE REQUIRED TO CORRELATE INTERNAL AND EXTERNAL READINGS.

BUMED - ACT
414

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COPY

FROM: BUMED

TO: COMWESSEAFRON

RELEASED BY: CAPT G M LYON

INFO: BUSHIPS
COMNAVBASE TERM IS
MED SEC RADSAFELAB
HUNTERS POINT CALIF

5 DEC 46

051942Z NCR 1217

ATTN COMMANDER HOFFMAN REF COMNAVBASE TERM RESTRICTED DISPATCH 280231Z NOV. PASS TO COMMANDER HOFFMAN. REQUEST YOU ASK WALSH TAKE UP WITH MEDICAL ADVISORY BOARD PROBLEM CLEARANCE SMALL BOATS IN LINE WITH WINNS REQUEST OF STATEMENT. HIS DESPATCH GIVES INFORMATION AS TO MAXIMUM READING ONLY AND NO BASIS FOR EVALUATING QUANTITY RELATIONSHIP. BUMED CANNOT CONCUR IN SMALL BOAT CLEARANCE UNTIL PROBLEM CONSIDERED BY MEDICAL ADVISORY BOARD WITH SUITABLE RECOMMENDATIONS WHICH TAKE INTO CONSIDERATION ULTIMATE DISPOSAL SUCH BOATS. NECESSARY THEY ESTABLISH CRITERIA FOR OPERATIONAL CLEARANCE AND FOR FINAL CLEARANCE. HULLS AND ENGINES TO BE CONSIDERED SEPARATELY AND SEPARATE CRITERIA ESTABLISHED.

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BUSHIPS ......414...OP04

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FROM: COMWESSEAFRON

TO: BUMED

13 NOVEMBER 1946

INFO: BUSHIPS

130127Z

NCR 4917

CANCEL MY 111917. BOARD RECOMMENDS STATISTICAL AVERAGE HULL READINGS WHEN SYSTEMATICALLY MONITORED OF .02 COMBINED BETA AND GAMMA DRY OR .014 WET FOR DISPOSAL AND INACTIVE. .1 BETA AND GAMMA AS MAXIMUM ALLOWABLE FOR ANY ONE ISOLATED AREA EXPLAINED BY COMDR FEE AND IS ACCEPTABLE. QUESTION B. .02 DRY OR .014 WET MEANS HULL WITHOUT HAZARD AND SATISFIES FINAL CLEARANCE REQUIREMENTS. QUESTION E. MEASUREMENTS INSIDE SHIP AND SHIELDED SUCH AS TAKEN ON SECTION OF PIPE BETWEEN SKIN OF SHIP AND INBOARD VALVE. REF PUGET SOUND SPDLTRS 0770 and 0775. SYLVANIA, WHARTON RECLAIMER BAYFIELD AND POLLUX WITHIN ABOVE LIMITS AND DO NOT REQUIRE DRYDOCKING. WALSH CONFERRING ON ADDITIONAL QUESTIONS.

BUMED ..... ACTION

BUSHIPS .....

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FROM: BUMED

TO: COMWESSEAFRON

9 NOV. 1946

082130Z

NCR 590

ATTN CAPT W E WALSH (MC)

REURDES 080145Z. REQUEST BOARD PROVIDE JUSTIFICATION FOR 2 STANDARDS FINAL CLEARANCE (A) ACTIVE AND (B) INACTIVE OR DISPOSAL WHEN ALL ARE POTENTIALLY OF LATER CLASSIFICATION. BUMED RECOGNIZED FINAL CLEARANCE AS MEANING NO POSSIBLE HAZARD SUBSEQUENT TO GRANTING FINAL CLEARANCE REGARDLESS OF WHAT DONE TO SHIP BUMED RECOGNIZES FINAL CLEARANCE FOR ANY SHIP BE BASED ON SHIELDED READING .001 AND UNSHIELDED .005. CLARIFY YOUR ANSWER QUESTION B "EXCEPT .02 ON HULL. DOES THIS MEAN WET OR DRY. DOES THIS MEAN HULL CONSIDERED WITHOUT HAZARD AND THEREFORE SATISFYING FINAL CLEARANCE REQUIREMENTS. ALSO YOUR ANSWER E DOES INTAKE OR OVERBOARD DISCHARGE CONSIDERED AS CONSIDERED HAVE MEASUREMENTS TAKEN FROM OUTSIDE SHIP UNSHIELDED OR INSIDE SHIP SHIELDED. CAN WE ASSUME BOARDS APPROVAL NOT DOCKING FOR RADIOLOGICAL PURPOSES SHIPS WITH HULL READINGS MAXIMUM ANY PLACE OR DOES THIS MEAN STATISTICAL AVERAGE WHEN SYSTEMATICALLY MONITORED ARE HULL READINGS INDICATED AS WET OR DRY. REQUEST MORTON PREPARE AND FORWARD AIRMAIL REPORT OF MEETING. DISPATCHES TOO BRIEF AND LEAVE TOO MANY OPPORTUNITIES FOR CONFUSION

SECOND COPY TO BUMED ....2100/13 MAR 47

ADD BUSHIPS ....PER BUMED 2100/13 MAR 47

BUMED ....ORIG

082130Z [redacted]

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Code 180 A
A11/Crossroads/S99

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NAVY DEPARTMENT
Bureau of Ships
Washington 25, D.C.

10 December 1946

MEMORANDUM

Subject: Conference on Radiological Safety; Report of.

Time: 0910, 27 November 1946.
Place: Navy Department, Bureau of Ships Room T3-2703.

Present:

R.Adm.	SOLBERG (BuShips)	Col.	NICHOLS (ManhatDist)
Capt.	MAXWELL (BuShips)	Col.	ROPER (ManhatDist)
Cdr.	FEE (BuShips)	Col.	FIELDS (ManhatDist)
Cdr.	HOFFMAN (BuShips WesCoRep.)	Col.	COONEY (RadSafe)
		Capt.	LYON (BuMed)
Cdr.	LANGER (BuShips)	Dr.	HAMILTON (Univ.Calif)
Cdr.	HAWES (BuShips)		

1. Admiral Solberg opened the conference by stating that radiological decontamination of Bikini non-target ships is now proceeding satisfactorily on the West Coast. About 90% of the vessels are expected to have final radiological clearance by 20 December. In the early stages many of the Commanding Officers were very much concerned over the suspected radioactivity hazards on the ships. They were also somewhat reluctant about prosecuting the decontamination vigorously. However, they have finally been convinced of the necessity for constant application until final clearance has been obtained. A new directive has now been issued by BuShips and BuMed covering the complete field of radiological decontamination. This directive had been read and approved by Dr. HAMILTON and Colonel COONEY. The new directive should stand as written for some time with the possible exception of a change in the hydrochloric acid solution used.

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2. Dr. HAMILTON reported that a new solution for decontaminating salt water systems is now under investigation. The new solution contains a mixture of hydrochloric and citric acids and under laboratory conditions removes 98-99% of the radioactive products. Dr. HAMILTON pointed out that this solution may be very important at some future date when very much larger quantities of fission products might require handling and the difference of a few percent would be critical. He did emphasize, however, that the problem of removing radioactive materials from the non-target ships at the present time is very much more difficult than would have been the case if they had been treated within a week or two after contamination. This is true because of the deposit of layers of other material over the original radioactive matter and also the diffusion of the fission products which has taken place over the period of time since the exposure. Dr. HAMILTON also stated that he is fully award of the fact that prosecution of decontamination processes in the laboratory is a much more simple matter than on board ships. For this reason he is very happy about the controlled decontamination which is being carried out on the ACHOMAWI and LST 881.

3. Admiral SOLBERG stated that he understood that the new solution of hydrochloric and citric acids was being tried on the CEBU and would like more information as to the details of the new mixture. He was advised that the solution acts more rapidly than one normal hydrochloric acid with a vigorous evolution of gas. It is actually one-half normal hydrochloric acid solution with an original Ph of a little less than that of one-half normal hydrochloric acid, perhaps 3 or 4. The first vapor given off is carbon dioxide resulting from reaction with calcareous materials. It is easier to handle and less dangerous than one normal hydrochloric acid solution. It is non-poisonous at all times and is not injurious to the human body with the exception of the eyes. It reacts on steel very slowly, but the only location in pipe systems where the effect might be noticeable at all would be on valve seats where perhaps a few ten-thousandths of an inch might be lost in the treatment. Admiral SOLBERG believed that one normal hydrochloric acid might still be quicker in removing heavy scale deposits as in evaporators. Dr. HAMILTON stated that the new mixture is better on general scale

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attack than is one normal hydrochloric acid although the new solution has not yet been tried on evaporator scale which is very dense and more difficult to attack than marine growth in pipes. Dr. HAMILTON agreed that the combination hydrochloric and citric acids should be tried on evaporators. Dr. HAMILTON reported also that a laboratory counter about one hundred times more sensitive than the X-263 has been set up for making a careful determination of the extent to which the radioactive materials can be removed with the new solution. Admiral SOLBERG voiced the opinion that perhaps the best treatment to settle on finally, might be use of one normal hydrochloric acid on evaporators to remove the heavy scale followed by a treatment with the new mixture to remove the remnant. He suggested trying this treatment on some ships with heavily scaled evaporators.

4. Admiral SOLBERG suggested that some fission products be left in a few salt water systems of selected active ships. Under this arrangement these ships would be retained in an operational clearance status over a considerable period for the purposes of study by sampling every six months to determine whether the erosive effects of the water circulation will act to remove the fission products. Dr. HAMILTON suggested, along this line, that samples of pipe sections be taken now on these ships and photofilm studies of the samples be made. The process should be repeated in six months by removing a section of pipe adjacent to the original sample for comparison and examination of the removal, diffusion or covering up of the radioactive materials. Captain LYON advised that this had in effect been started on the BURLESON by running alpha counts on scale, but the samples were too weak showing no alpha in twenty-four hours but definitely showing the presence of plutonium on a 30 day test.

5. Admiral SOLBERG mentioned the desirability of investigating wood samples and painted surfaces, also, to study the behavior of fission products present and the possibility of migration of the material over a long period of time. Dr. LYON stated that a man is available in the Public Health Service to make the necessary examination of samples. Dr. HAMILTON stated that he is familiar with the work of this man who has not had experience in making radioautographs. It was suggested that the man be sent to University of California for a short period of training in the laboratory and then returned

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to his own laboratory to carry on the necessary work which will require only part time. It is highly desirable that the work not be done at University of California because of the crowded conditions there. The man in question is of Turkish origin, but is an American citizen, and has great abilities. Col. FIELDS stated that he could be granted necessary clearance for the work at Berkeley.

6. Admiral SOLBERG believes that immediate and careful consideration should be given to the decontamination program to insure that valuable information and opportunities for research will not be destroyed in the haste to obtain radiological clearance on all non-target ships as soon as possible. He stated that studies of salt water systems can still be made on some of the target ships which had diesel generators operating and used portions of firemains in a highly contaminated part of the lagoon subsequent to Test BAKER. Examples of such ships are PENSACOLA, SALT LAKE CITY, NEW YORK and NEVADE. He also cited the fact that entire sections of contaminated piping systems could be removed from these targets and reinstalled in active ships for experimental purposes. The PRINZ EUGEN and NEW YORK will also offer excellent samples of contaminated wood decks, while these and other target ships will yield good painted surfaces for migration studies.

7. Another problem brought forth by Admiral SOLBERG was that of the four submarines, PARCHE, SEARAVEN, DENTUDA and TUNA now at Mare Island and only negligibly damaged. There is a possibility of a saving in funds if these vessels can be put in satisfactory use for reserve training cruises. If this action were taken, these vessels also would present excellent cases for study. The recent program of decontamination has been based on clearing non-target ships as soon as possible and waiting for the return of targets before initiating extensive decontamination research. However, the four submarines mentioned provide an immediate field for such studies. A wash of the new hydrochloric-citric acid solution might be tried. All known means of decontaminating these vessels were tried at Bikini, but they still remained above operational clearance limits as now established. Upon arrival at Mare Island the readings were in general within tolerance levels on the topside but with a few high spots. All had been painted over. Dr. HAMILTON noted that when painted over, the plutonium does not present a hazard. He also stated that the present gamma radiation is from

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zirconium and columbium and even if as high as [illegible] R/day will be safe within four months. It was agreed that the four submarines may be of some value in the investigation fields, but not nearly so much as active ships which still have parts contaminated.

8. The question of treatment of work decks was raised. Dr. HAMILTON stated that there is no known method of handling radiological contamination of wood decking other that removing and disposing of it. He did reiterate, however, that investigation of the effect of various solutions on the contaminated wood should be made and the migration of the fission products under treatment should be studied by use of radioautographs. Furthermore, he believed that an attempt should be made to determine whether the contamination before treatment is located only on the surface or permeates the material. Admiral SOLBERG stated that if the radioactive materials are only on the surface treatment with a liquid will probably carry it further in. Commander HOFFMAN reported that experience at Bikini in planing contaminated wood decks showed that the activity extended through a layer at least 3/16" thick. Dr. HAMILTON advised that a few samples of wood deck be obtained and checked to study this matter. It was reported that some samples of wood deck as well as steel plate specimens are now at Hunters Point, but no investigation work has progressed on these, as yet. There are also some samples at Los Almos on which very little has been accomplished according to Col. COONEY. Admiral SOLBERG reported that he has received no reports on the Los Alamos samples.

9. Dr. HAMILTON reported that Drs. MORTON and MORRISON have been of invaluable assistance at Berkeley and have been carrying the brunt of the Navy's radiological investigation work at the University of California. Dr. HAMILTON also expressed the desire to have two other naval officers replace MORTON and MORRISON at the University when the latter shift to the Hunters Point Laboratory. Admiral SOLBERG said that he wanted to relieve the University of California of as much of the actual work as possible while still obtaining their advice in the operation of the Hunters Point Laboratory. He definitely does not want to lose the relations with the Crocker Laboratory just because the Navy is setting up its own laboratory. Commander HOFFMAN reported that several of the monitors are very much interested in radiological investigation work and two are actually working in the Hunters Point Laboratory.

When the clearing of the non-target ships has been completed it is possible that these two monitors might go to Berkeley. In response to a question from Captain LYON, Admiral SOLBERG reported that BuShips expects to train radiochemists for its phase of the work just as BuMed is training them for biochemical research. Dr. HAMILTON considered that BuShips will have need for a greater number of trained radiochemists than BuMed will. He further mentioned that the physical part of the work was simple and that the chemical was by far the most important. Captain LYON advised that Drs. MORTON and MORRISON will be utilized in the future as biochemical radiochemists in assessing health hazards and establishing radiological tolerances and limits. Dr. HAMILTON believes that at least one of the replacements for Drs. MORTON and MORRISON should be a BuShips officer. Captain MAXWELL advised that a Lt. PRESTON, who has a Ph.D. in chemistry from the University of California, and is now engaged in petroleum research in BuShips, will be available for radiological work on 2 December and can go to Berkeley if desired.

10. Col. COONEY advised that Col. NICHOLS would arrive at the conference about 1000 and desired to discuss the security aspect of radiological decontamination. Admiral SOLBERG said that preliminary discussion should be undertaken prior to Col. NICHOLS arrival to save time. The Admiral presented as the most pressing question of security that relating to drydocking and the disposal of marine growth and sand-blasting sand from contaminated ships. Dr. HAMILTON stated that the quantities of sand involved were so immense and the amounts of plutonium so small from any ship that the dilution of the radioactive material was sufficient to render it impossible for anyone to obtain any information from the sand. He said, the sand could safely be used for paving or construction. He was advised, however, that the sand is not suitable for construction and is used generally only for fill. Admiral SOLBERG pointed out that Col. WARREN had been worried about dumping the sand at high places because of the possibility of contaminating water supplies. Dr. HAMILTON refuted this point by inviting attention to the fact that all water soluble materials would have left the ship's bottom prior to docking, hence no concern as to disposition of the sand should arise provided ship's bottoms were no more than 3 to 4 times as active as the ROCKBRIDGE.

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The recommendation was, therefore, that no special disposal of sand from non-target vessels was necessary. Marine growth on vessels not radiologically cleared should be disposed of by sinking at sea, however, since 30 to 40 lbs. of dry algae would offer good possibilities for radiochemical analysis Target vessels with 4-20 R/day would give rise to concern over sand disposal. Admiral SOLBERG advised, however, that it was at present not contemplated that any cleaning of target ship bottoms would be undertaken except for scraping of small areas to conduct structural examinations. He further stated that the present plan is not to sell targets for scrap and the probable final disposition will be sinking. No problem of disposal of material in docks will arise because the targets will remain for only short periods, perhaps three or four days, during which practically no marine growth will fall off. No docking hazard is likely to arise since the target ship bottoms are not particularly radioactive. The SKATE, when docked in Mare Island, had readings varying from .05 to .3 R/day. The HUGHES was docked at Bikini with no danger, and particular attention was given to the condition of the bottom to determine what hazard might be expected from this source. Admiral SOLBERG attributes the low concentration of fission products on the underwater bodies to the plastic paint which apparently does not absorb the active products. Further, most of the targets will have been lying in Kwajalein for a considerable period, during which much of the activity will have been rejected by exfoliation, and much more will be washed off during the long return trip. Hence it is not likely that any problem will arise as a result of radioactivity on target ship bottoms.

11. With respect to disposal of acid solutions used in cleaning salt water systems, Dr. HAMILTON believes that quantities up to one curie of fission products can be dumped into a harbor in a six months period without hazard. In most cases the material will settle into the mud where it will do no harm and the dilution factor in a large harbor such as at Puget Sound or San Francisco is so great that no concern need be experienced. Another reason for not being alarmed about discharging the used acid solution into harbors is the fact that a large number of the non-target vessels will not be accomplishing the operation in the same locality simultaneously. Dr. HAMILTON was certain that the dumping

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of used acid solutions from an average of not more than one vessel per week in one geographical location would be perfectly safe. Capt. LYON advised the conference that Col. WARREN had been of the opinion that not more than five vessels should be permitted to dump acid solutions used in removing radioactivity concurrently in one harbor. Dr. HAMILTON advised that consideration be given to the public relations angle in not permitting the information to leak out regarding the local disposal of acid and sand containing some fission products in spite of the fact that the quantities involved entail absolutely no health or security hazard. Adm. SOLBERG stated that in view of the progress already made in the decontamination program the Navy could probably continue to dump the acid solutions at sea but would benefit greatly by elimination of the need for special disposal of the sand. Dr. HAMILTON agreed but advised that if the sand should leave Navy property, the persons receiving it not be advised of the source because of their likely failure to understand that no hazard from radioactive materials existed.

12. Dr. HAMILTON stated that the principal security problem lies in disposal of Bikini ships for scrap. He definitely considered the new directive absolutely safe with resepct to limits for radiological clearance. He went on to explain that the plutonium in a ship, which may be several hundred micrograms, is mixed intimately with so tremendous a gross quantity of rust and scale that the cyclotron would be a much more efficient means of obtaining the element. As to determining the efficiency of the bomb from the fission products present, Dr. HAMILTON believes these ships would be very poor because of the change in characteristics of the deposits as a result of the cleaning solutions used on interior systems, and the erosion and exfoliation on the underwater bodies with time of immersion. In fact, he said, the desert sands at Alamagordo provide a much better source for bomb efficiency analysis.

13. At 1010, Col. NICHOLS and Col. ROPER joined the conference. Admiral SOLBERG summarized for the new conferees the conclusions on security which had thus far been reached in the conference as follows:

(a) There is considered to be no problem of security requiring disposal of sand used in sand-blasting non-target vessels. The marine growth removed should, however, be disposed of by sinking at sea.

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(b) It is also considered unnecessary to make special disposition of solutions used for cleaning ships' salt water systems, but for the present the existing practice of dumping at sea will be followed.

Admiral SOLBERG went on to explain that it is highly desirable, if possible, to avoid special drydocking of non-target vessels before disposal. Since the period elapsing between the present time and the actual disposal of such vessels by the Maritime Commission will be more than a year, no hazard from radioactive materials is deemed to exist.

14. Dr. HAMILTON explained that two principal considerations had governed his conclusions in security matters.

(a) Source of plutonium. After decontamination to established limits, perhaps 100 micrograms of plutonium remain in hundreds of thousands of feet of pipe mixed with thousands of pounds of scale, rust, and the like. To separate out the plutonium from this gross material would be a tremendous job. On the other hand, a small cyclotron could easily produce a milligram of plutonium in a year. Consequently, the ships are considered to represent no security hazard from the source of plutonium standpoint.

(b) Bomb efficiency. The amount of fission products obtained from kilograms of contaminated material on a ship would be very small and most unreliable because of selective leaching and solution selection on cleaning of systems. The best source of samples of products would be underwater body plates, but even in that case with as much as tens of kilograms of scrapings, there is no probability of obtaining a reliable estimate of efficiency. Dr. HAMILTON was positive of the uselessness of samples of material from salt water systems which had been acid cleaned, but said the underwater hull was not necessarily subject to the same disproportionation.

Admiral SOLBERG, however, believes that the exfoliation on the underwater body upsets the proportions of materials present. Dr. HAMILTON suggested that some hull samples be tested at University of California to check this point. If the materials reveal the possibility of a risk involved, the matter will re reviewed. If not, as anticipated, and it is as difficult as believed to run an essay, the entire matter can be dismissed

[redacted]

as no security concern. Meanwhile, Col. NICHOLS agreed that special docking for non-target decontamination will be dispensed with until and unless Dr. HAMILTON's investigations indicate the contrary to be necessary. With respect to target vessels the present plan is not to sell or scrap, hence they do not enter this problem at the moment. Captain MAXWELL pointed out that several ex-targets are now at Norfolk and with the cancellation of the special tests for which they were earmarked are now preparing for routine disposal. Captain LYON pointed out, however, that these particular vessels are to be excluded from all target vessel considerations and are to be regarded as non-targets from the standpoint of decontamination.

15. Admiral SOLBERG stated his desire to have bomb efficiency assays conducted on samples from several locations on returning target vessels. Dr. HAMILTON believes six representative samples will be sufficient to provide the necessary information. He also believes that the plate samples now available from target vessels may be satisfactory for the purpose. Col. ROPER stated that perhaps the Maritime Commission should be advised to hold back any Bikini vessels turned over for disposal until Dr. HAMILTON's assays are completed. Dr. HAMILTON expressed the belief, however, that any special considerations requested would arouse undue suspicion as to the safety of handling the ships. Col. NICHOLS rendered the decision that the program of disposal will proceed normally as already decided, keeping a record of which vessels having been exposed are turned over for disposal, and the Navy will step in when and if it becomes necessary as a result of the bomb efficiency assay.

16. Dr. HAMILTON advised that there need be no concern over melting down scrap from the non-target ships. The only point to be considered in this respect is the possibility of using this means to determine the bomb efficiency. To do this would require separating out one of the fission products which is an extremely difficult operation. At present the only products which still lend themselves to separation are the long life cerium or europium. Col. NICHOLS decided that in this case, also, the only special precaution would be to keep a record of which ships are involved until Dr. HAMILTON completes his bomb efficiency investigations.

17. Dr. HAMILTON raised the question of the possibility of unauthorized persons entering Bikini Lagoon and obtaining samples for efficiency analysis. Admiral SOLBERG advised that no one is on the islands, the lagoon is a closed port and periodic flights are made from Kwajalein to insure that unauthorized entries are not made. It was admitted that there would be considerable difficulty in obtaining samples but some of the sand in the lagoon is still at 50 R/day. Dr. HAMILTON stated that only a small sample would be required and could be located by means of any ordinary geiger counter. He also noted as significant the fact that several foreign nations had ordered counters from this country. The possibility of disproportionation of fission products by plant and animal life present was raised. Dr. HAMILTON responded that there might be some but it would be insignificant. He suggested that to verify this statement and to check the hazard to security represented by Bikini, some samples of sand be obtained for assay if Col. NICHOLS desires. Col. NICHOLS stated he would like to have this done if it could be accomplished without undue difficulty. Admiral SOLBERG recommended that arrangements be made to have Captain DRAEGER contact Atoll Commander Kwajalein with respect to obtaining the necessary sand samples from Bikini.

18. Col. NICHOLS raised the question as to whether there was any possibility of successful suits against the government by agencies receiving the non-target ships for scrap. Dr. HAMILTON, in response, stated that no such possibility existed because of the small quantities of fission products which would be present in the scrap. He did say that there would probably be many suits by cranks, but none of these would be valid, and it would be foolish to try to work towards avoiding them. Col. FIELDS said that Gen. GROVES is very much afraid of claims being instituted by men who participated in the Bikini tests. Dr. HAMILTON said in response to this possibility, that there is much authoritative information available to prove that plutonium in the form contained in the bomb is not absorbed by the digestive tract or through the lungs unless quantities as large as a gram are being dealt with. He also believes that the health hazards from long life fission products are far greater than from plutonium. These fission products are strontium and cerium which are very rare, however. Furthermore, plutonium in the form being dealt with does not go to the skeleton which is the principal danger of the stontium and cerium. The

amounts of dangerous fission products to be found in the scrap would be on the order of 50 millecuries, in tons of slag where it would be found. This quantity is on the order of the amounts of radium found in ordinary rock. Therefore, Dr. HAMILTON is willing to state positively that there is absolutely no possibility of physical injury from radioactive materials in the amounts which are being worked with on the non-targets under present conditions.

19. Dr. HAMILTON was very anxious to determine whether the present arrangements with University of California are satisfactory. Admiral SOLBERG stated that the Navy is highly pleased with developments and is completely open to suggestions and changes recommended by Dr. HAMILTON. Dr. HAMILTON said that he is interested in giving all the service he possibly can, and that all arrangements are completely satisfactory to him provided the Navy is getting all the information it needs.

20. Captain LYON raised the question of security of information in connection with the transfer of safety and decontamination functions to the Bureau of Medicine and Surgery and the Bureau of Ships. Captain LYON advised that a joint conference had considered that a section working directly under each Bureau Chief, preferably a small group with no intermediaries, should be charged with handling high security matters relating to radiological work. Col. NICHOLS advised that this matter will become a responsibility of the military liaison committee of the Atomic Energy Commission upon dissolution of the Manhattan District. Admiral SOLBERG advised that the Bureau of Ships is perfectly satisfied to permit his little group do whatever is required provided there is no undue interference with allocation of funds or operational schedules. Captain MAXWELL raised the question of clearance of civilian personnel who will be working in the new Radiological Laboratory. Col. FIELDS said that these people, if citizens, can be cleared very easily by Manhattan. Col. NICHOLS said he thought the clearance procedure should be maintained by the Atomic Energy Commission after Manhattan dissolves. Dr. HAMILTON said that if he can be advised of what personnel will be connected with the Hunters Point Laboratory and what their clearance status is, it will simplify his problem in determining how much information should be made available to each individual and he will be happy to supply it.

21. Admiral SOLBERG advised that when the new laboratory gets into operation many security problems will be likely to arise in connection with personnel obtaining information on past procedures and reports of work accomplished. This information will be essential to avoid repetition and useless work. Commander HOFFMAN is very desirous of obtaining a copy of the Manhattan (University of Chicago) Handbook and Dr. SEABORG's lecture notes on nuclear chemistry to assist in establishing the laboratory. Dr. HAMILTON said that most of the Hunters Point problems will involve plutonium and fission product chemistry. If the personnel are cleared, Dr. HAMILTON will make the information available to them in the form of selected reports. Commander HAWES reminded Dr. HAMILTON that he had agreed to set up a list of the reports of this type which can be made available. Dr. HAMILTON said that the handbook would not be of much value in setting up the laboratory although portions of it might be useful in a general way. In any case, Dr. HAMILTON will provide information to Commander HOFFMAN as to what equipment is required.

22. Dr. HAMILTON advised that personnel were still very scarce in radiological work at Berkeley. He has recently been able to hire only one man on a part-time basis. The Manhattan District is having great difficulty maintaining sufficient personnel, also. Dr. HAMILTON has no promising students available at the moment for the new work, but expects to attempt to obtain additional graduate students for training. The new Hunters Point Laboratory is considered to be a very attractive spot for a young man who will be interested in a permanent, civil service job, and should bring forth some promising candidates. Dr. HAMILTON will confer with Commander HOFFMAN further in this matter at San Francisco.

23. At 1110 all Army personnel left the conference in order to take care of immediate business.

24. The remaining conferees continued the discussion of the security problem somewhat further. On the basis of the previous findings of the conference it was decided that considerable effort and expense could be saved by dumping into harbors rather than carrying to sea the acid solutions used in decontaminating salt water systems. It was therefore

decided to permit activities to dump the acid into harbors slowly and preferably on an ebbtide. Dr. HAMILTON was requested to advise Col. NICHOLS of this decision.

25. With respect to provision of samples for the investigations to be conducted by Dr. HAMILTON on the possibility of determing therefrom the bomb efficiency, it was decided that Commander HOFFMAN would arrange to obtain the samples from docked ships on the West Coast. About five pounds of the sample materials are to be obtained from locations on the underwater bodies which monitor about .02 R/day (the present average clearance limit). The samples are to be marked in detail as to the locations from which they were taken and the radiation readings at those locations.

26. It was also decided that the use of the new combination hydrochloric and citric acid solution would be limited to the San Francisco area at the outset. Later Commander HOFFMAN may extend the use to Terminal Island and San Diego if he deems it appropriate and so desires.

27. The conference adjourned at 1145.

/s/ J. J. Fee

J. J. FEE
Commander, U.S.Navy

cc: 100
101
200
[illegible]
[illegible]
[illegible]
All present at conference.

APPENDIX VI

DIRECTIVES FOR FUTURE DECONTAMINATION

UNCLASSIFIED

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON 25, D. C.

Code 180

NY9-1

18 November 1946

AIRMAIL

C[redacted]AL

From: The Chief of Bureau of Ships.
To: Commander Naval Shipyard, San Francisco.

Subj: Laboratory for Radiological Studies; Supplement to Present Laboratory Facilities for.

Ref: (a) CNO Conf. ltr Ser 021P602 of 27 August 1946.

Encl: H.W.
Copy of Ref (a).

1. Reference (a) established a radiological safety program for the Navy. The Bureau of Ships has been directed to: (a) Develop instruments for detection of radioactivity; (b) Develop equipment for protection of personnel on shipboard; and (c) Develop methods and equipment for decontamination of ships. One of the measures necessary to implement this program is the establishment of laboratory facilities for radiological investigations.

2. Present laboratory facilities at Naval Shipyard, San Francisco, shall be increased to carry out the above additional functions. Provision shall be made for estimation of radioactive contamination and development of methods and procedures for decontamination, studies of contamination by radioactive materials, and allied investigations. These facilities shall supplement, and cooperate with, activities of the Naval Establishment having direct cognizance of other phases of the radiological safety program.

S[redacted]

UNCLASSIFIED

3. Installation of necessary equipment and facilities will be charged to Project Order 595/46 which is being increased by \$50,000, for this purpose. An itemized estimate of the cost of this work is requested. Maintenance and operation will be charged against a new Project Order, 286/47 in the amount of \$25,000, being issued. Estimates of these costs are also requested.

4. Naval Shipyard, San Francisco, will engage additional technical personnel; each person must be approved by the Bureau of Ships. Any increase in civilian personnel ceiling that becomes necessary shall be referred to the Bureau, Code 700. The Bureau will also request assignment of an officer to duty in the Shipyard as head of the new activities who will not be charged against the shipyard officer allocation.

5. The Bureau of Medicine and Surgery also will utilize the facilities of this laboratory for making studies of physical radiological hazards and such work in connection therewith as is associated with decontamination. That Bureau will provide officer personnel, equipment and supplies for work under its cognizance.

6. It is estimated that the services of seven technical men will be required immediately for work under Bureau of Ships cognizance. Several qualified personnel available to the Bureau of Ships can be assigned. Initial efforts of this group shall be directed toward solution of problems of decontamination of non-target CROSSROADS Ships. Work on similar problems for CROSSROADS target vessels will be undertaken when these vessels become available. It is expected now that these facilities will be utilized for a continuing research and development program.

C. D. WHEELOCK,
Rear Admiral, USN,
Deputy and Assistant
Chief of Bureau

cc:
- CNO
- CWSF
- BuMed
- ComServPac
- Com 11th, 12th, 13th, 14th N.D.
- BuY&D
- BuAer
- All West Coast Shipyards plus Pearl Harbor

[redacted]

NAVY DEPARTMENT

OFFICE OF THE CHIEF OF NAVAL OPERATIONS

WASHINGTON 25, D. C.

OP-602/cmf
Serial: 021P602
(SC) S67-1

27 August 1946

[redacted]

From: The Chief of Naval Operations.
To: All Bureaus, Boards and Officers of the Navy Department.

Subject: Establishment of a Radiological Safety Program for the Navy.

1. In order to cope with the full implications of atomic warfare, and to discharge to the fullest extent the Naval responsibilities for the conduct of tests, experiments, and development in atomic weapons, including the completion of Naval aspects of Operation CROSS-ADS, it is necessary that an organization and a program for radiological safety be established within the Navy with the least practicable delay.

2. The radiological safety program will involve procurement and training of personnel, design and procurement of instruments and special equipment, establishment of safety policies, standards, and regulations, research in decontamination procedures and physiological effects and their treatment, and other aspects peculiar to this safety hazard. It is desired that the organizational structure be laid down at an early date in order that the Bureaus and offices of the Navy Department may proceed along well defined lines of action in the discharge of their respective responsibilities.

3. The following general areas of cognizance and responsibility are hereby established:

Areas of Cognizance and Responsibility for Establishment and Execution of Radiological Safety Program.

[redacted]

CNO	- (a)	Establish policies with respect to: (1) Organization. (2) Equipment. (3) Personnel qualifications, assignment, and training. (4) Educational program for the Navy.
	(b)	Coordinate Bureau activities.
BuMed	- (a)	Establish safety tolerances and regulations.
	(b)	Determine physiological effects and develop treatment methods.
	(c)	Approve specifications for instruments to cover medical aspects.
BuShips	- (a)	Develop and procure instruments for detection of radioactivity.
	(b)	Develop and procure equipment for individual and collective protection of personnel on shipboard.
	(c)	Develop methods and equipment for decontamation of ships.
BuPers	- (a)	Establish training and educational program and conduct schools.
	(b)	Establish and promulgate qualification standards of personnel assigned to Radiological Safety Program.
BuOrd, BuAer BuSandA	- (a)	Within their fields of cognizance set up coordinate and advisory activities to develop a well rounded decontamination and protection program for the Navy.

[redacted]

BuDocks - (a) Develop and procure equipment for collective protection of personnel ashore.

(b) Develop methods and equipment for decontamination ashore.

s/s D. C. RAMSEY
Vice Chief of Naval Operations

AUTHENTICATED BY:

C. B. HART, Lt (jg) USNR (W)

C-607

Copy

[redacted]

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON 25, D. C.

C-S99-(0) (689)

[redacted]

14 January 1947.

To: Commander, Pearl Harbor Naval Shipyard.
Commander, Puget Sound Naval Shipyard.
Commander, San Francisco Naval Shipyard.

Subj: Radiological Examination of CROSSROADS Target Ships.

Ref: (a) CNO Dispatch 280345Z November.
(b) BuShips ltr. Serial 1599 of 26 December 1946.

1. Reference (a) designated the Crossroads target vessels to be returned for detailed examination at Naval Shipyards and specified the tentative dates of arrival at the respective yards. Reference (b) outlined the scope of the work required to be undertaken except that no specific instructions were given concerning the radiological examination required. The special radiological examination of the target vessels is designed to exhaust the vessels of all factual data on radiological conditions which may conceivably be of significance. These data shall be segrated suitably and subjected to field analysis, then submitted to the Bureau of Ships for further analysis and dissemination to interested Bureaus and offices. A Bureau of Ships representative will arrange, at the appropriate time, in consulatation with the Naval Shipyard San Francisco Radiation Laboratory, the priority of investigations. At that time suitable arrangements will be made for the submission of progress reports.

2. The radiological examination will consist of monitoring the vessels in accordance with the instructions given below. In addition respective shipyards are authorized and directed to remove such samples and lend such assistance as may be requested by special monitors from the Radiation Laboratory at San Francisco Naval Shipyard. In carrying out the examination of the target vessels the special precautions and radiological safety measures prescribed by the Bureau of Medicine and Surgery will be observed.

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3. The Radiation Laboratory at San Francisco Naval Shipyard will conduct the following studies:

(a) In order to facilitate later examination of the ships conduct tests as expeditiously as practicable to determine any respiratory hazard which may be engendered by various operations aboard the ships. The radiological effects of placing the ships ventilation system in operation, where feasible, and of operational activity aboard ships simulated by sweeping various types of contaminated surfaces which exhibit graduated levels of activity should be separately analysed by taking filter samples. The samples may be taken in a manner similar to that used to determine the hazard resulting from sandblasting. In addition, it is desired that the adequacy of the type of filter used be investigated by taking check samples behind it using a Navy B-2 gas mask canister as a filter. Similarly, collection should be made of the smoke and fumes resulting from welding and burning on contaminated surfaces at various levels of radiation intensity. Adequate pictorial documentation is requested.

(b) Investigate the effect of varying the orientation of the radiation instruments with respect to the surface being measured. The effect of adjacent large radiating areas on the radiation readings obtained on deck areas is to be checked under the varying conditions found aboard the Target Vessels. The effect of the above factors will be required to evaluate local decontamination measures.

(c) Make a complete and accurate radiation survey of the entire ship as promptly as possible after arrival. This survey is to be made by the specially trained monitors assigned to the Radiation Laboratory. The Roentgen readings for Gamma and Gamma plus Beta radiation should be recorded separately on the ships booklet of general plans. Readings on decks and platforms are to be taken at intervals of five frame spaces from bow to stern and at equivalent intervals from beam to beam. Readings shall be taken on all exterior vertical surfaces at somewhat more frequent intervals. The readings and extent of local areas showing unusually high or low radiation should be defined adequately and located on the same general arrangement plan used above. Interior readings may be spaced at greater intervals in spaces not opened to the weather. However, at all openings such as ventilators, hatches, stacks, and in way of normal access passages readings should be spaced closely.

[redacted]

Every effort should be made by the use of the proteximeters and by film techniques to obtain an integrated radiation level for all ship control, operating and living spaces aboard. It is desired that representative areas showing the various graduated levels of radioactivity be documented by taking location identifying and detailed close-up photographs of the surfaces. Similar documentation of areas showing unusually high or low radiation levels should also be made.

(d) Collect samples of each type of surface, i.e., wood, painted steel (which may include the several types of paint as separate categories), stainless steel, ceramics, manila, etc. Such samples should be taken for each significant level of radioactivity found and from both vertical and horizontal surfaces. The samples should be documented completely (in place photographs being very desirable) packaged and shipped to the Radiation Laboratory at San Francisco Naval Shipyard. All loose, very highly radioactive material should be gathered up and shipped to the laboratory for possible future use and study. In packaging the samples for shipment, due precautions must be observed to prevent scattering of contaminated material in transit and loss of the contaminators from the samples. The use of the moisture proof overseas type package is recommended. The exterior of the shipping container is to be marked clearly "radioactive material" and should not have a radiation intensity of more than .1R per 24 hours. Where shipment is to be made by commercial carrier, attention of the shipyard must be invited to the existence of regulations for the shipment of radium and/or radioactive materials.

(e) Conduct experimental decontamination of suitably limited topside areas aboard the target ships on each of the various types of surfaces found aboard naval vessels. Such areas are to be chosen after consultation with the Bureau of Ships and the Bureau of Medicine and Surgery representatives. This will of necessity follow the development of a promising method in the laboratory. It may be necessary or desirable to decontaminate radiologically, by an practicable method, certain areas aboard to simplify inspection work.

(f) The laboratory should obtain such additional data and conduct additional studies as deemed feasible or necessary, after approval of the projects by the Bureau of Ships.

(g) The samples returned to the labortory at San Francisco are to be used as follows:

(1) Analyse sufficient samples quantitatively and qualitatively to establish the correlation between radiation reading in Roentgens and quantity and quality of radioactive products present on the several surfaces.

(2) Make a detailed and careful study of all the chemical and physical properties of the contaminating materials. The size, shape, distribution, and other properties should be determined with accuracy to provide a standard by which at a future date the contaminating action of a bomb explosion may be duplicated in the laboratory. This is of greatest importance as the veracity of the results of tests of future countermeasures developed will depend in large part upon the rigidity with which the contaminating action of an atomic bomb may be duplicated.

(3) Conduct laboratory radiological decontamination of the various surfaces and materials to develop feasible methods for field application.

(4) Conduct detailed, accurate analyses of all the various ship surfaces, i.e., their porosity, surface phenomena related to absorption, etc. Made such correlation as practicable between such characteristics which appear to be significant and quantity and nature of fission products present, with due cognizance being taken of the effect of aging, leaching and surface deterioration since the Baker Test. Some of the significant factors can be evaluated by comparison with similar analysis of samples on hand which were removed from selected target ships the last week in August. The Bureau of Ships will assemble a log of the weather to which the Targets under study were subjected since Baker Day for use in analysing results.

(5) Conduct such other studies or analyses as are considered feasible or necessary, advising the Bureau of Ships of such action taken.

4. Charges for the shipyard work involved in the above examination may be allocated to project orders as follows:

[redacted]

Pearl Harbor	593/46
San Francisco	595/46
Puget Sound	597/46

F. W. WALTON
By direction of
Chief of Bureau

CC:

CNO
BuMed
CWSF
Com14
Joint Task Force Committee
BuOrd
BuAer
ONR

Classification (~~Cancelled~~) (Changed to ~~CONFIDENTIAL~~)
by Authority of Joint Chiefs of Staff Action of 15 April 1949
By John Biggs Capt AFSWP Date 26 August 51

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USE MILITARY

SECRET

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ATOMIC ENERGY ACT 1946

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